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OLD STONES.

NEW EDITION.

A Series of Geological Notes

ON THE

PLUTONIC, VOLCANIC, PRE-CAMBRIAN, CAMBRIAN,
SILURIAN, AND DEVONIAN ROCKS IN THE
NEIGHBOURHOOD OF MALVERN,

WITH A CHAPTER ON DRIETS.

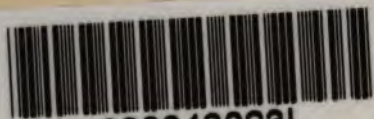
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Rector of Pendock.

LONDON : SIMPKIN, MARSHALL, AND CO.
MALVERN : WOODS & CO.
TEWKESBURY : WILLIAM NORTH.
1884.

PRICE TWO SHILLINGS.

22.5.23

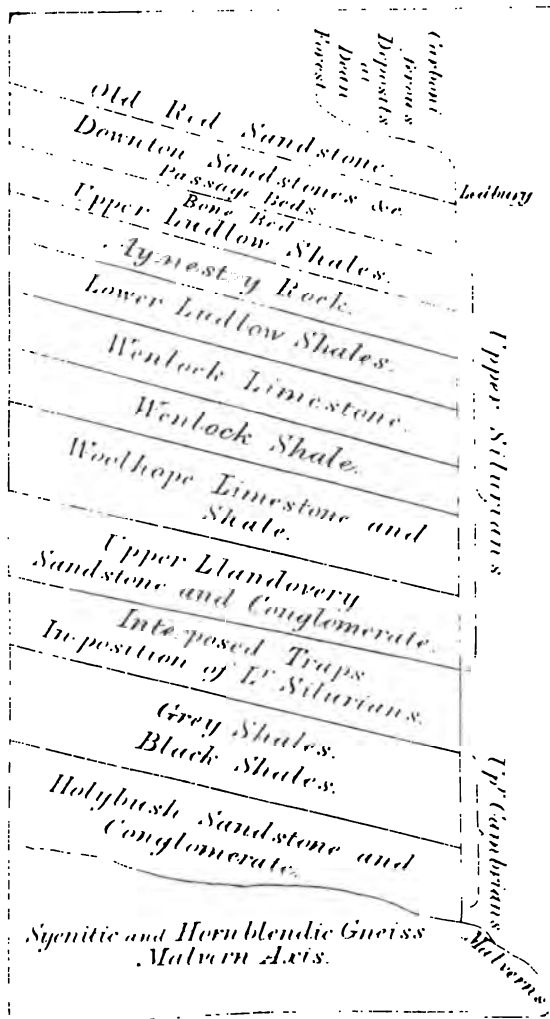


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SECTION FROM THE S. MAVERNS AT WHITE LEAVED OAK TO LEDBET



To
THE MEMBERS
OF THE
NATURAL HISTORY FIELD CLUBS OF THE
WEST OF ENGLAND.

Friends and brother Naturalists, accept the dedication of this edition of "OLD STONES," in memory of much kindness, hospitality, and courtesy received by me for many years.

W. S. SYMONDS.

PENDOCK, 1884.



OLD STONES.

CHAPTER I.

The Malvern Hills: their Geologic Structure—Plutonic, Volcanic, and Crystalline Rocks—Earth once in a Fluid State—Recent Volcanic Action—Etna—Skaptar Jokul—Vesuvius—Coseguina—Rocks of the Malverns most like Lavas—Valley of the White-leaved Oak—Roots of an Ancient Volcano in Ragged Stone and Midsummer Hills—Igneous, or Trap, Bosses at Ragged Stone Hill and Cowleigh Park—Plutonic Rocks—Malvern Boys and Minerals for Sale—Malvern Donkeys—Silix, Felspar, and other Malvern “Spars”—Basalt and “Ballstones” above Branshill Castle—Quarry in Plutonic Rocks at Wind’s Point, on Holly Bush Hill—British Caer on Midsummer Hill—Quarries on North Hill, and Igneous Dykes there—Duke of York and Somers Arms Inns—Igneous Dykes in the Malverns of different dates—Laurentian Gneiss, or oldest Sedimentary Deposits—Section above Little Malvern Church—Dr. Holl—Equivalents of Ancient Sedimentary Rocks of Malvern in Scotland and America—Oldest known Fossils—Longmynd seen from the Malverns—Lower Cambrian Deposits and Fossils wanting at the Malverns—Upper Cambrians represented—Upper Cambrian, Conglomerate and Fossils in, at Holly Bush and Ragged Stone Hills—Holly Bush Sandstone and Fossils—Building Stone of—Miss Selwyn’s Chapel—Black Shales and their Fossils East and West of Malvern Axis—Miss Margaret Lowe discovers *Obolella* in—Grey Shales with *Dictyonema*—Historical Scenes from the Southern Malverns—Gloucester, Deerhurst, Tewkesbury, Haffield, Eastnor, Castleditch, Branshill Castle—Legends of the Ragged Stone, Moreton Court and Birtsmorton—Sir John Oldcastle there, and Cardinal Wolsey.

“WHAT may those hills be, Sir?” said a gentleman one day, as the train was running rapidly along between Worcester and Cheltenham. I replied, “Oh, they are Plutonic rocks.” My fellow traveller looked

up with an inquiring stare, and his countenance expressed a half doubt whether or not I was in my sober senses. I then informed the stranger that the picturesque hill range we were rushing past was the well known chain of the Malvern Hills. One question led to another, and I endeavoured to explain that the term "*Plutonic*" was applied by Geologists to rock masses which had once been fused and melted like the lava of volcanoes; but that *Volcanic* rocks and lavas were cooled and crystallised at the surface, whereas *Plutonic* rocks, such as Granite and Syenite, had been cooled and crystallised from a molten state under great pressure and often at considerable depths in the bosom of the earth. The term was derived from Pluto, the ancient god of hell. This conversation took place as long ago as 1854. A few years later and I might have informed my fellow traveller that the researches of Dr. Holl, of Worcester, and other geologists, have established the fact that not only do Plutonic and Volcanic rocks enter into the structure of the Malvern range, but that regularly stratified masses or sedimentary deposits, which must have been accumulated in water and have since been altered and crystallised, also combine with igneous masses to form the Malvern axis.

The Malvern Hills are really a small chain of narrow elevated land, sloping steeply from its central axis. There are no plateaux, as in the Welsh Hills, and the northern slopes are destitute of wood. On the western side they throw off a series of strata which, with their hard limestones, form a hilly country; while, on a foggy day, the eastern side looks like a sea strait, or a great inland lake, with the Cotswold Hills rising as the opposite coast, and Bredon Hill, and a few others, rising as islands from

the waters. And such indeed was the history of the "Severn Straits," in days comparatively recent; when the Mammoth and the long-haired Rhinoceros roamed along the Malverns on one side, and the Cotswolds on the other, shores of a marine strait, which extended from the estuary of the Severn to that of the Dee. The length of the whole Malvern chain is not above nine miles from the extreme end of the North Hill to that of the Chase End on the south. The Andes and the great Indian mountains are thousands of miles in length; but a distinguished American standing upon the Ragged Stone, after he had comprehended the geologic history to be seen from the ridge of the Malverns, declared, in the presence of the author and his friends, that he doubted "whether in all the world there is so much of geologic interest to be seen in one single panorama as is contained within the views to be seen from the Malverns and the country and rocks they comprehend." The rocks which enter into the structure of the Malverns are not precipitous peaks, but they are very ancient. The passes are not high, but they have re-echoed to the tramp of armies; and Romans, Saxons, Danes, and Normans must have traversed them. Until within the last three centuries great forests covered their base, and both Great and Little Malvern were religious houses with humble villages. Thousands of visitors frequent the far-famed hills of Malvern, and it surely must be a matter of interest to many to understand that the axis or ridge upon which they stand consists of rock masses once molten like the lavas of volcanoes, and of ancient sedimentary stratified rocks which have themselves been fused and altered by heat; that the Herefordshire Hills upon the west are uptilted beds,

or strata, which once covered up the masses which constitute the Malvern ridge ; while the strata on the east are much newer and of later deposition than those to the westward. Earthquake action and volcanic action are both exhibited in the Malvern range. Long ages ago the molten masses, the Plutonic rocks, and the old Metamorphic strata, which now form the Malverns, were consolidated and afterwards were upheaved. But a few words upon the history of subterranean forces, now in progress in our own times, may be useful before we allude to the changes and complicated disturbances which have occurred in the Malvern district, or before we can understand the letters of that alphabet which constitutes the language of " Old Stones."

VOLCANIC ROCKS.

It is generally admitted by philosophers who have investigated the evidence, that large areas of the interior of the earth are occupied by molten, fiery masses of minerals and metals, and that it is probable that, once upon a time, the solid materials of our globe were in a fluid state. Calculations have been made respecting the external crust of the planet we inhabit, and its thickness. But only a very small part of the interior of the earth is accessible to the observation of Man ; and we know little or nothing of the 4,000 miles from the point below our feet to the Earth's centre. We do know, however, that volcanic action is at present active in upwards of 300 localities at different parts of the Earth's surface, and that the lava torrents of more than 300 active volcanoes from time to time pour forth their fiery contents at different parts of the Earth's crust. The vast region of

the Andes of South America is one enormous range of mountains studded by extinct volcanoes, intermingled with others which are still active ; and the immense Pacific Ocean is almost surrounded with a series of volcanoes ; while on the Atlantic side volcanic activity appears to have been far more rife in earlier epochs of the Planet's history than at present.

We may form some idea of the enormous force exercised by the heated vapours and gases beneath a volcanic vent from the fact that a column of lava or molten rock would have to be upraised to the height of nearly four vertical miles before it could overflow from the summit of the volcano of Chimborazo in South America ; or more than two miles in Etna. The masses of molten rock and minerals which are ejected from a volcano are called lavas ; but these are not the only volcanic products, for various gases and enormous volumes of heated water, or steam, rise from all active volcanoes. With these, too, are ejected fine dust, volcanic ashes, and stones, which descend in showers and often cover many square miles of country around the craters or volcanic vents.

The effect of lava currents upon a country can only be understood by visiting some volcanic district like that of Iceland, Etna, or the regions of Auvergne in southern France—where, although the volcanoes have ceased to be active, volcanic phenomena are still preserved upon a grand scale.

Mount Etna has poured forth from its craters, at different times, streams of lava, some fifteen, some twenty, and some thirty miles in length. In fact the whole of that great mountain, which is nearly 10,000 feet high and 90 miles in circumference, is almost entirely made up of volcanic matter. In one

eruption (1669) the burning torrent of molten rock overwhelmed a space fourteen miles in length by four in breadth, and buried beneath it more than 400 human habitations. The volcano of Skaptar Jokul, in Iceland, burst forth in 1783, and poured forth lava currents for six years without ceasing. Large and deep valleys were entirely filled up by the floods of lava; and one stream extended to fifty miles in length by twelve miles in breadth; while another was forty miles long by seven in breadth.

The destruction of the cities of Herculaneum and Pompeii, by the eruptions of Vesuvius, the overwhelming of the town of *Stabiae*, in the time of Pliny, and the destruction of Torre del Greco, in 1794, are examples of the effects of volcanic eruptions since historic times. As regards the effects of the outburst of volcanic ashes, we may mention the volcano of Coseguina, in Central America, of which Sir Charles Lyell records that the volcanic dust and ashes covered the surrounding country for a distance of twenty-five miles, to the depth of ten feet, destroying the woods and human dwellings. Thousands of cattle perished, birds and wild animals were found suffocated in the ashes, and the streams were strewn with dead fish. Some of the finer dust and ash travelled in the air 700 miles.*

Again, the regions which are most convulsed by earthquakes are those which include within them the site of the most active volcanoes; and earthquakes sometimes extending over vast areas, precede volcanic eruptions. We have many proofs of earth movements along the flanks of the Malverns in days gone by. Mr. Darwin, who had seen the effects of earthquake action throughout extensive regions in

* Principles of Geology, 11th Ed., p. 584.

South America, says that, "Daily it is forced home on the mind of the geologist, that nothing, not even the wind that blows, is so unstable as the crust of this earth." And, indeed, it may be said that not a year passes that the crust of our globe does not somewhere or other undergo a change of level—some parts of the earth rising, some sinking. The great earthquake, which was so fatal to Lisbon (1755), was felt in the Alps, in Sweden, the West Indies, and in Canada; while Sir Charles Lyell records how subterranean disturbances, in New Zealand, produced a fracture in the strata, which extended for a distance of ninety miles, as late as 1855. The land was elevated in places as much as nine feet, while in others a subsidence occurred.* The vast plains of Patagonia are covered with marine shells, the species of which are now living in the Pacific Ocean; while great tracts have been submerged at the mouth of the Indus. The observation of travellers in the Arctic regions tell us how land is rising in Greenland and Spitzbergen; while there is every reason to believe that the coral islands of the Indian and Pacific Oceans are growing upon the summits of a submarine continent, which for long ages has been gradually sinking beneath the waves. In fact not a day passes in some part of our globe without some up or downward movement of the Earth's crust.

As regards the Malverns, we can, within the limits of a short walk, behold evidences of earth movements, and study rocks which have been poured forth by volcanic agency. In certain localities we may see beds of lava, in others Plutonic masses; while the evidences of earth movements and displacements will be alluded to in their separate localities.

* Lyell's *Student's Elements*, 3rd Ed., p. 67.

LAVA ROCKS OF THE MALVERNS.

Before I speak of the other Igneous rocks of the Malvern chain, I will direct attention to certain localities where certain volcanic masses, which are most like true *lavas*, may be observed. The two hills at the southern extremity of the Malvern range are known as the Chase End and Ragged Stone hills. The Chase End takes its name from being the last hill in the ancient Chase of Malvern, and its right name has become corrupted through mispronunciation into Kaison, Keysend and Chaseun. The Chase of Gloucester almost met Malvern Chase at Murrell's End, in the parish of Redmarley, and both these chases were once claimed by Gilbert de Clare, the powerful "Red Earl" of Gloucester. Between the Chase End and Ragged Stone hills is the valley of the White-leaved Oak, beautiful in spring time, with its banks covered with the primrose and the violet, and in summer and autumn with the scarlet foxglove and the yellow gorse. But it is the most remarkable among all the peaks for its Geology, and may be reached from "The Duke of York," on the eastside of the hills, and "The Somers Arms" on the west.

On the west side of the Ragged Stone, between the pass of the White-leaved Oak and Fowlet Farm, are the "Trap bosses," long ago described by Professor Phillips in his work on the "Geology of the Malvern and Abberley hills;" and he says "that in no part of the Malvern hills are the trap rocks more varied in character than in the Ragged Stone; nowhere do they depart more widely from the syenitic type and approach more nearly to the ordinary aspect of eruptive trap, abounding in compact felspar." These

"trap bosses" have since been characterised by Dr. Holl as "*lavas*," and certainly nowhere along the line of the Malverns do we meet with rocks which may so truly be spoken of as lavas as in those volcanic outbursts which traverse the black shales and run along the bases of the western sides of the Chase End, Ragged Stone, and Midsummer hills. There is one small opening in these bosses, in a field between the White-leaved Oak and the Fowlet Farm, where the trap contains augite, a well-known constituent of the lavas of Etna and Vesuvius. This little boss is nearly in the middle of the field, and in summer time is generally blue with the flowers of the *Echium vulgare*. Another rises like a sepulchral mound nearer to the Fowlet Farm; while a small section may be seen on the high road to Eastnor, on the left hand side and between the Holly Bush Pass and the entrance gate to Branshill. Professor Phillips describes the rock here as "in part rudely prismatic and partly in a soft decomposed state, with large desquamated balls." This is a good description, for in some later excavations there were exposed some very columnar looking masses, as if a series of large cannon balls had been laid one above another. Crossing the high road another of these lava bosses may be seen above the ruins of the ancient castle of Branshill. We see no more of these peculiar traps until in the neighbourhood of North Malvern there is an exposition in Cowleigh Park of trap supposed to be of the same date.

I have drawn attention to these volcanic lava rocks more particularly because they are more like true lavas than any other igneous masses in the Malvern district, and, as I am informed by mineralogists, contain augite.

PLUTONIC ROCKS OF THE MALVERNS.

We take, next in order, another series of igneous rocks displayed in the Malvern range, which are as truly volcanic as lavas, or volcanic ashes, or pumice, but which differ in their form of crystallisation, owing to their becoming solidified and cooled under greater pressure. All who visit the Malverns and climb the Worcestershire Beacon will encounter small boys with big baskets, who persecute them to buy "Spar, Sir?" or "Gold Mine, Sir?" or "Silver Mine, please Sir?" These entreaties are just as persistent as the request to bestride "the very same donkeys" which once "carried Her Majesty, Queen Adelaide," or "the Royal Princess Victoria." Now, the "spar" is quartz; the "gold mine" sulphuret of iron pyrites; and the "silver mine" is a micaceous rock; while now and then some other minerals, such as epidote and crystallised hornblende, with crystals of felspar, may be met with in the boys' baskets. In the College Museum, and in Dr. Grindrod's collection, at Townshend House, are hand specimens of all the minerals of the Malvern axis.

One of the spars, or quartz, is silix in its purest form; and silix enters largely into the composition of some of the rocks of the globe, as sandstone and sand, which are both made up of grains of silix; thus sandstone rocks are termed *siliceous* rocks. Flint is another form of silix, and quartz is silix crystallised. The unaccustomed eye will sometimes confound quartz crystals with crystals of carbonate of lime, which the Malvern boys obtain from the Wenlock quarries, on the west side the hills, and sell as "Spar, Sir." One sure test, however, is that

quartz rock will not effervesce with acids, while carbonate of lime will do so on the slightest touch. Silix is an important mineral to the vegetable world, as it enters largely into the straw of our corn crops and grasses; but it is not a simple or elementary substance, being a combination of silicon and oxygen. Hot springs in many parts of the world, as the hot springs of America and New Zealand, Iceland and the Azores, have their waters charged with dissolved silix, and deposit it at the surface of the earth in siliceous masses, just as in Auvergne, and other districts, waters hold carbonate of lime in solution, and deposit it when exposed to the air on birds' nests, snail shells, or a hundred other objects which are placed for the saturated waters to drip on. Quartz enters into the structure of lavas, and especially of trachytic lavas; indeed, the mineral from Auvergne, known as Tridymite, is silica crystallised on the cooling of lavas. Now, the other spars are crystals of a very different kind of rock, viz., carbonate of lime, which forms the basis of that great division of rocks known as calcareous rocks, which are composed of lime and carbonic acid. Corals and shells form their habitations of this material, which they obtain from the waters.

Another mineral, called Felspar, is of considerable importance. The crystals are often of a flesh-coloured red, and may be seen in the walls built of Malvern stones. As there is a group of quartz rocks with varieties of the forms of crystallisation of silix, so there is a felspar group of potash felspars, or soda felspars, &c., arranged according to their system of crystallisation. This mineral is one of the constituents of argillaceous or clay rocks. Its combination with quartz or silix produces alumina or clay; and as

clay soils have much to do with the conditions of our earth, we can understand that felspar is as worthy of our consideration as quartz and its siliceous rocks, or lime and calcareous rocks. Hornblende, mica, and epidote are also minerals which are found in the Plutonic rocks of Malvern. There are many varieties of hornblendic rocks with long names, but it is sufficient to say that it is that dark greenish mineral everywhere so common in the rocks of the Malverns. Hornblende contains calcium, the metallic base of lime, and magnesium the metallic base of magnesia. Fine specimens of crystallised hornblende may be seen at the College Museum, and these came from North and West Malvern; also from the interior of the hills when perforated by the Tunnel of the railway from Worcester to Hereford.

Mica is the "silver mine" of the Malvern boys. The mica group of minerals all contain potash, and sometimes forms beautiful transparent plates, which are used for windows in Russia. A micaceous rock glistens in the sun, whence the name "silver mine." A micaceous schist may be seen in a quarry at the base of the Ragged Stone, near the pass of the White-leaved Oak.

These minerals are found principally in what we broadly term the "syenitic rocks of the Malvern axis." But we shall see that these rocks have for the most part *been stratified*, and thus were at one time or another spread out in layers under water. They have then put on their present crystalline appearance, owing to some change which occurred since they were originally in the state of mud, or silt, or sandy deposits. This change we believe to have been brought about by Plutonic action, viz., intense heat, and great pressure; so we rank them

with Plutonic rocks, especially as some of the syenitic masses have evidently been melted into a liquid state and have lost all signs of former stratification. The name Plutonic applies better to those truly igneous outbursts which are interbedded, like sheets of lava, in the old stratified layers, or shot into crevices and fissures and there have cooled and become consolidated. Such are what may be termed Plutonic lavas, such as dolerites, diorites, greenstones, and trap rocks.

Those who have visited The Giant's Causeway, or Staffa and Iona, or still more the volcanic regions of Auvergne, will remember the wonderful basaltic columns of those regions. Basalt differs little from modern lavas, and may be said to be a crystallised dolerite. The columnar structure of basalt was a puzzle until Mr. Gregory Watt showed, by experiment, that it originated from the manner in which it cooled down. Mr. Watt melted a mass of basalt and kept it in the furnace several days after the fire was reduced. It fused into a dark-coloured vitreous mass with less heat than was necessary to melt pig iron; and when cooled down again into a stony mass it was converted into polygonal prisms. Those who examine the little quarry alluded to, between the Holly Bush pass and Branshill, or the "ball stones" above Branshill Castle, at the trap mound, will see how easily this igneous rock would have become columnar like basalt.

There are many large quarries where examples of Plutonic rocks may be seen along the North Malverns; some are hornblendic, some syenitic or felspathic, and here and there we meet with dykes of greenstone or diorite. There is a fine quarry at the Wind's Point, on the high road between Malvern and Led-

bury; and here we have a mass of greenstone or diorite which appears to have been shot up in a fissure in the syenitic gneiss. Syenite derives its name from the quarries of Syene, in Egypt, and contains felspar, hornblende, quartz, and mica; and we see a good deal of it in various parts of the Malverns. It seems, however, that this rock was, originally, mechanically formed under water but has been altered into what is termed a *Syenitic Gneiss*. We shall consider it under the head of Sedimentary Rocks of the Malvern district.

A fine quarry of diorite or greenstone may be seen on the Holly Bush Pass, between Tewkesbury and Ledbury. The Camps of the Herefordshire Beacon and the Midsummer Hill may be said to consist of syenitic gneiss traversed by veins and dykes of diorite, such as is exposed in the great quarry of roadstone on the pass of the Holly Bush. This great dyke runs nearly the whole length of the hills, and was excavated near their centre, where the Railway tunnel passes south of the pass of The Wyche. It is, we doubt not, a prolongation of the great injected dyke of the Holly Bush and Ragged Stone hills. When masses of volcanic matter are injected into fissures or clefts in stratified, or indeed in unstratified rocks, they are called Trap dykes, from "trappa," a Swedish term for stairs; for many rocks of this kind occur in tabular masses and form a series of steps. All along the Malvern axis Plutonic rocks may be studied.

The great quarries of the North Hill show amorphous masses of syenitic and hornblendic rocks, which have evidently been fused and melted into homogeneous rock. Here and there you perceive dykes in these crystalline masses of a different

mineralogical character, and on examining them we find that the syenitic rock has been split and that these dykes have been erupted into the fissures, the molten matter having become cooled and consolidated in the fissures. Such examples may be best seen at a quarry on the north-west on the road to West Malvern, where nearly opposite Cowleigh Park, the trap which appears in Cowleigh Park seems to have been erupted by a lateral fissure into the syenitic axis itself. The last time I was there it was nearly quarried away.

Another locality is on the west slope of Swinyard Hill, where there is a small quarry of the syenitic rock, with a dyke of greenstone erupted into it. Perhaps the best example is at the Gullet quarry, above the village inn, "The Feathers," at Castle Morton, on the eastern side of Swinyard Hill. Here, a year ago, I was enabled to show Professor Hughes, of Cambridge, a "reglar chimbley" in the syenitic masses. It was a hard mass of greenstone, of a tendency to form basaltic columnar structure and which, broad at the base, terminated in a thin peak without penetrating to the surface. Of course, being good road stone, it was quarried at once. It must not be supposed that the igneous rocks of the Malvern axis all belong to one epoch. No one who observes carefully can avoid seeing that there have been infiltrations into the chain at different periods. Along the Southern Hills there are sections which apparently show old lava streams interbedded with the old syenitic strata; and their igneous rocks differ from those to the North.

It is necessary to draw a distinction between the truly igneous rocks, which enter into the range of the Malvern axis, and the syenitic bedded rocks, or gneiss; because the gneiss looks so truly igneous,

sometimes, that it is difficult to believe it was ever as much a stratified rock as are the Cambrian shales which lie above it and against it. If we are right, however, in supposing that at some quarries along the Swinyard, Holly Bush, and Ragged Stone Hills, we see beds of Plutonic rock, or ancient lavas, interbedded with the stratified gneiss, then we are looking upon masses of volcanic rocks which were erupted and poured forth over the beds of an ocean which appertain to the most ancient epochs in the Planet's history with which the geologist has to deal.

Astronomers and physicists tell us that the Solar System was shot off from the Sun; that this Earth was not only, once, without form and void, but that it was in a gaseous condition, and in the course of ages was condensed into a fluid state. The heated fluid masses then congealed until a crust was formed, and as the internal hot molten nucleus shrank inwards the crust of the earth underwent foldings and crumplings of the surface like the rind of a withered apple. When condensation began in the surrounding atmosphere, it is believed that the great deep was created and waters filled the hollows in the crust, and the dry land stood out in ridges of Plutonic rocks. These theories, however, are outside the facts with which geologists have to deal.

We start with the evidence that we find volcanic rocks, which seem to have been contemporaneous with the earliest stratified rocks. We know that volcanic rocks, whether they are modern lavas or the interbedded lavas of very ancient volcanoes, or dykes, or roots of old volcanoes, or volcanic ashes, derive their origin *from the interior of the earth*. Again, we know that all stratified rocks must have been formed

at the surface of the earth's crust, from the waste of land which had become elevated above the seas, and acted upon by rain and snow, frost, air, and springs and rivers. It is with these we deal, and we have proofs in the Malverns that there are volcanic sedimentary rocks of untold antiquity.

The southern Malverns are *the* hills the geologist loves to visit ever since the days when Leonard Horner penned his paper on the "Mineralogy of the Malverns," in the early days of English geology; and Phillips wrote his Memoir on the "Malvern and Abberley Hills." In the little room at the "Duke of York," below the Holly Bush, or at the "Somers Arms" on the western side, have assembled from time to time those masters of that great science, who learned themselves, and taught to others, the wondrous history which the examination of the Earth's crust has unfolded. Those quarries by the hill sides, and the little hollows in the Black Shales, have exercised the intellects and called forth exclamations of wonder and delight from the author of "The Principles" (Sir Charles Lyell), from Murchison and Sedgwick, from John Phillips, and Adams the Astronomer, from Strickland and Harkness, Jardine, Robert Chambers, The Earl of Enniskillen, Agassiz, De la Harpe, Hughes, Etheridge, Hooker, and a score of others, many of whom, alas, are now in the grave!

OLDEST SEDIMENTARY ROCKS OF THE MALVERNS.

(*Laurentian Gneiss.*)

To those who are acquainted with the elements of Geology, stratified deposits, aqueous rocks, mechanical rocks, and strata, are very simple terms, and

convey a meaning at once understood. There are many, however, to whom such terms are new, and to such I may be allowed a few words of explanation. It is almost impossible to travel through any country with eyes observant, without remarking rocks which lie in layers and beds with the utmost regularity, and they are called stratified, because they are accumulated layer above layer, and stratum above stratum. On examination many of these strata are found to be made up entirely of water-worn materials, and to have been deposited in the bottom of some sea or lake. They often, too, contain thousands of fossil shells, fossil fish, and other animals which are known to have been the inhabitants of seas or lakes. Again, these sedimentary formations are often exposed with their edges upturned from the horizontal position they once occupied, showing that the flat surface they once were spread over has been subjected to upward or downward movements of the Earth's crust. Sometimes strata are found resting nearly horizontally on the upturned edges of rocks which had been dislocated and upheaved before the upper series of rocks were deposited. This history may be seen on a small scale in several localities along the Malvern range, and the exposition is a lesson for the physical geologist worthy of examination.

If we examine the section presented by the road side cutting above the picturesque relics of Little Malvern Church, on the road to the Wind's Point, we shall see that the syenitic and hornblendic rocks are in certain places regularly stratified in layers. Although we find quartz, felspar and hornblende in the layers, they are stratified like sheets of mud or sand or limestone. They are seen to be dislocated, at the great quarry at Wind's Point, by greenstone

dykes penetrating the layers. Still bedded they are! This stratification of the "old gneiss" was observed long ago by Sir Roderick Murchison, Strickland, and Phillips; but it remained for a Worcestershire Geologist, Dr. Holl, to indicate the probability, that these old stratified rocks are of the same age as the Laurentian strata of America, and fragments of an ancient land which existed untold ages ago in the north west of Scotland and the Hebrides, in Scandinavia, and in Finland, as well as in North America. This old Malvern "gneiss" is a remnant of the first land the geologist traces in the records of the vast past, and a record of the oldest, known, sea bottom before it was upheaved into land. The Malvern ridge is a portion of that primeval land which was exposed above the waters ages before either Cambrian rocks or Silurian strata had a beginning. Again, the ancient muds and shales which once formed an ocean bed, and which were derived, probably, from the wear and tear of Plutonic rocks, have been for ages altered into crystalline layers just as we now see them, for we detect fragments of their crystalline structure in the ancient Cambrian sediments which overlies them.

The North Hill at Malvern and the Worcestershire Beacon present great masses of hard, crystalline, Plutonic rocks, traversed here and there by dykes of diorite and greenstone, and now and then we may detect masses of the old, baked, gneiss, showing stratified laminæ. These rocks are exposed in the cutting at The Wyche, where a vein of chloritic rock is seen on the right hand of the eastern entrance full of igneous masses. It is not until we reach the neighbourhood of The Wind's Point that we see well the bedded structure of the stratified syenitic and horn-

blendic gneiss. But if this crystalline gneiss of the Malverns is a fragment of that ancient continent from which was derived the debris which made up the overlying Cambrian strata, what was the history of the seas in which the Laurentian gneiss was itself laid down, and what life was there in those waters which once rolled over the ocean beds which are the oldest we know of in all the hoar antiquity of geology? The earliest condition of the earth is necessarily the darkest period of its geological history, and the most eminent geologists believe that there was a long period when the internal heat of the earth so affected the first surfaces and crust that it was impossible that living organisms could exist. Researches have shown that in America there is a vast series of crystalline rocks more than 30,000 feet in thickness and occupying an area of 200,000 square miles, which the most reliable authorities, such as Dr. Sterry Hunt, Professor McKenny Hughes, of Cambridge, Dr. Zirkel, the mineralogist, Dr. Holl, Dr. Hicks, and M. Renard, all believe are the equivalents of the oldest stratified rocks of Scotland and the Hebrides, which Sir R. Murchison named "fundamental gneiss." These, I believe, are also the equivalents of our Malvern gneiss! In the American rocks Sir W. Logan discovered (1859) the fossil remains of a lowly organised animal, which Dr. Dawson, of Montreal, Dr. Carpenter, and Professor Rupert Jones, all agree to have been a Foraminifer.

Foraminifera are animals which may be said to belong to the microscopic life of the ocean, for their numbers surpass all human conception. From the deep seas the dredge brings up billions of foraminiferous shells, for the animals are covered with beautiful siliceous shells, which under the microscope

show very elegant forms, some like nantili, others like the fossils known as nummulites. M. D'Orbigny reckoned that there were nearly four millions of these microscopic shells in a pound of sand from the Antilles. The oldest known Foraminifera were of large size, and seem to have formed solid masses of limestone, as do the coral animals.

Eozoon (Dawn of Life) is the name given to the ancient foraminifer, which is found in the oldest-known sedimentary rock in America, but has not yet been detected in our English or Scotch rocks of Laurentian age.

Well does the old gneiss of the Malvern range deserve the homage of geologists. There is very little doubt that it was laid down in the waters of a sea when the Eozoon of America was forming limestone masses, and that it was afterwards the land of a continent which stretched away to Scandinavia, when the Cambrian ocean washed its shores and eroded its rocks. Whether trees and plants grew upon this old land of upheaved gneiss we know not. We know of no animal then created to wander among its hills and vales. But we do know that a number of animals lived in the seas which washed the old land of Malvern gneiss, and Plutonic rocks, were tenants of the Cambrian seas, and we have some of these on the flanks of the Malverns.

CAMBRIAN ROCKS OF THE MALVERNS.

If we refer to the ladder at the beginning of this treatise, we shall see a rude representation of the stratified rock masses of the British Isles, and which we travel over in passing from our western coasts of Wales to the eastern coast of the Isle of Wight.

The strata are all represented by different colours on a geological map of England and Wales. So in travelling from the coasts of Anglesea and Bangor to Malvern we ascend from lower to higher beds. The Cambrian rocks are covered by Lower Silurians, Lower Silurians by Upper Silurians, and these again pass under the Devonian or Old Red Sandstone, while the Devonian are covered by the Carboniferous deposits. These stratified masses are now to a considerable extent shifted from the horizontal positions they once occupied, one above the other, and we may read them off like books arranged in a library. Each of the volumes, too, have within their leaves, or layers, types of the Creator's, a printing of God's works, and a history so marvellous that none but those who have read and studied the pages of that library can form the remotest conception of its wonders. In order to understand the characters of the Cambrian rocks we refer our readers to the works of Sir Charles Lyell.* Along the Malverns, Cambrian rocks are but poorly represented and only the Upper Cambrians are seen at all. But standing on the Malvern ridge, and looking beyond the High Vinnals of Ludlow and the bold mass of the Titterstone Clee, we see the Longmynd stretching in a long line from west to east. Here the Lower Cambrians may be studied, and Mr. Callaway has lately found the Upper Cambrians, also, between the Longmynd and the Stiper Stones. These hills are more Welsh-like than the Malverns, being covered with heather, the haunts still of the black cock, the red grouse, the curlew, and the ring ouzel. There are bogs, too, which furnish the

* "Student's Elements," 3 Ed. p. 480; and "Principles of Geology."

pinguicula, the marsh violet, and cotton grass, none of which now grow upon our Malvern hills. The Lower Cambrians of the Longmynd are the equivalent rocks of those round the ruins of Harlech, or the grey rocks above Barmouth; also of those which rest on Laurentian gneiss on the shores of the beautiful Loch Maree and the wild Loch of Torridon in Rosshire; or tower above Loch Assynt and Loch Inver on the coast of Sutherland. In Wales the Lower Cambrians have supplied a remarkable group of fossils to the researches of geologists, and we owe our principal knowledge to the exertions of Dr. Hicks, who has given to the strata the term "Menevian" the classical name of St. David's. The Menevian rocks contain many species of the crustacea known as Trilobites, one of which, the Paradoxides, would have sufficed for a man's breakfast. Trilobites, as far as we know, were the most abundant animal of these Lower Cambrian seas. A Cystidean has been found, an animal allied to the sea urchin; and a Star-fish is known in the Cambrians of Sweden. With these are some small brachiopods or shellfish, such as Obolella and Lingulella; but no gasteropodous shells, such as Periwinkles, or Naticas; and no lamellibranchs, such as the oyster, have yet been found in rocks so ancient.

The Upper Cambrian rocks of the Malverns consist of (1) conglomerate at the base, (2) the greenish Holly Bush sandstones, and (3) the black and grey (Dictyonema) shales. They can only be studied along the western and, in one locality, the eastern flanks of the southern Malverns.

The Cambrian Conglomerate.—This old shingle beach, when it can be seen, for it is very difficult to

find in position, rests directly on, and may be said to stick to, the Plutonic and Syenitic axis. It was exposed at the great quarry at the Gullet Pass, under the Swinyard Hill, and may be detected on the opposite side the gorge in ascending towards the Eastnor Obelisk. It lies at the base of the Holly Bush sandstone, both on the flanks of the Midsummer and Ragged Stone hills, and may be seen, in situ, not far from a cottage garden in the little hill valley formed by the spurs of the Ragged Stone as they face the Ledbury road. Excavations for stone on the western slope of the Ragged Stone, exposed this old beach dipping at a high angle underneath the greenish Holly Bush sandstones. It is a very different rock from that known as "Miss Phillips's conglomerate," which is of the Llandovery series, for it contains many rounded quartz pebbles, and is very different in the crystalline character of its structure. The fossils, too, are altogether different. As fossils belonging to the May Hill or Llandovery series are found in Miss Phillips's shingle beach, so are fossils of the Cambrian age found in this Holly Bush conglomerate. They are very rare, but an *obolella* occurs with the rounded pebbles probably of the same species as that in the overlying pale-coloured felspathic sandstones which pass upwards into greenish grits. *Obolella*, with *Lingulella*, are the earliest known forms of mollusca, or shell fish, and with trilobites, are found in the Lower Cambrians; so this small brachiopod is an important fossil to the geologist, and marks an important position at Malvern. Some years ago, when, in company with some old friends, we were engaged in showing M. Agassiz, jun., these rocks and the black shales, we found both the shells just alluded to, and they had the honour of

a journey to America, to be introduced to their relations in the Potsdam sandstone.

Holly Bush Sandstone.—These greenish grits are so called from the Holly Bush Pass, and from the number of holly trees which clothe the eastern spur of the Midsummer hill, and which is called Holly Bush hill.

They are traversed by volcanic rocks, which appear as bosses on the south-west flank of Midsummer hill, one of which is exposed in a small quarry, and has been figured by Professor Phillips. The lower beds have yielded two or three species of obolella, and two small lingulas (or lingulellas); and the greenish grits above furnish some cylindrical casts supposed to be caused by the perforations of sea worms, and called *Trachyderma antiquissima*. On breaking the grits there are sometimes seen small holes which penetrate into the rock. These have been termed *scolithus*, a name applied in America to sets of holes in the Potsdam sandstone, which geologists are of opinion were the work of marine animals. These specimens, and those of *trachyderma*, are but poor sport for the collector, but all fossils from rocks on this horizon are of consequence, as the geologist will find, should he perchance receive a visit from his brothers of the hammer from America, Bohemia, Norway, or Sweden.

The first thing that strikes a geologist, who has visited a volcanic country, respecting the Holly Bush sandstone, is that it looks like a "volcanic grit," or a rock that is made up of materials which have been ejected from a volcano. This was the view, too, of Sir R. Murchison. It was probably consolidated from a mass of volcanic grit and ashes which were

erupted from a volcanic vent which was situated where now are the Ragged Stone and the Midsummer hills. If this was the case, the grit must have fallen into the sea, for the materials have certainly been sorted by water and are regularly stratified. The best exposition is at the quarry on the left-hand of the high road to Ledbury, near a cottage. It makes a fine building stone as may be seen in the chapel built by Miss Selwyn, on Castlemorton Common, or the village school at Birtsmorton. It contains, the mineralogist says, a good deal of iron which oxidises at the surface of the stone when exposed to weather. In some places this greenish sandstone rests unconformably upon the old gneiss, without the intervention of the conglomerate. Such is the case at the great quarry above the pass of the White-leaved Oak where a saddle of the Holly Bush sandstone overlaps each side the hill and is seen dipping to the east as well as to the west.

Several years ago, when Professor Phillips sketched it for his Memoirs, the great quarry of the White-leaved Oak, showed the junction of the Holly Bush sandstone with the old gneiss far better than is to be seen now; though the arching and bending back of the greenish grits may be seen at the top of the quarry. The quarry lower down, on the east, which was evidently commenced in hopes of quarrying the syenitic axis or a Plutonic rock, dips to the eastward into the vale. Here the Holly Bush strata have furnished specimens which have been supposed to be furoids, or casts of sea weed, and here and there the cast of an obolella, but it is very unfossiliferous.

Black and Grey Shales.—Both on the east and west sides of the axis, near the White-leaved Oak,

the greenish grits may be seen overlaid by black fossiliferous shales, and these again in other localities pass upwards into pale grey shales which contain a very characteristic fossil, *Dictyonema sociale*. One point here we must especially direct attention to! Some years ago in sinking a well for the cottage on the left-hand side (just above the foot-bridge, in ascending the lane from the Hawthorns to the White-leaved Oak) the Black shales were seen to rest against *the eastern side* of the axis of the hill as well as on the western slope. They were dipping at a very high angle and thus proved an elevation of the axis since the deposition of the black shales. The heap that was thrown out proved to be very fossiliferous and furnished beautiful *Oleni*, which are small trilobites, and the *Agnostus pisiformis*, a little crustacean which is abundant in Upper Cambrian strata in North Wales, America, Scandinavia, and Bohemia. This section is no longer visible, and it was fortunate that attention was directed to it by Mr. Hugh Strickland who discovered that these shales contained the *agnostus*. The Black shales were overlapped on this eastern side of the axis by the lower New Red deposits (Bromesberrow sandstones); and it is well worth a short walk farther westward to see how the New Red rests against the syenitic gneiss of the Chase End hill. You merely ascend the path leading from the Hawthorns to the Chase End.

A reference to the classification of the Cambrian group of rocks, by Sir C. Lyell,* will show how many more beautiful fossils, besides these found at Malvern, have been obtained from the Upper Cambrians of

* "Student's Elements," Ed 3, p. 420.

Wales, at St. David's, near Tremadoc, and on the north of Cardigan Bay, in Carnarvonshire. A few words upon the history of the ancient group of animals found in the Cambrian rocks may not be uninteresting to those who are commencing the study of geology. Trilobites belong to the order of animals known as Crustacea, of which lobsters, crabs, and shrimps, are familiar examples. They are found in the Lower Cambrians of North Wales, America, Scandinavia, and Bohemia, and several of the primordial genera are remarkable for their size and form. The Paradoxides would have been sufficient for a man's breakfast, whereas the Oleni are all small, and the Agnostus not much larger than a pea. These animals had no legs, underwent metamorphosis like other crustacea and insects, had the power of rolling themselves into a ball, and, in the mature stage of their growth, were furnished with beautiful compound eyes. With the exception of the Eozoon they are among the earliest known inhabitants of the earth's surface, but they have for long ages become extinct, no trilobite having been found in any rock of later date than the Carboniferous. The Oleni are not easy to find in the Malvern district, for there are no sections. The shales may be obtained from the hedge bank, in a field called "Coal Hill," near the White-leaved Oak, from the fact that a pit was sunk for coal in these Cambrian shales about fifty years ago, and all the money was sunk with it. The shales split badly unless they are first exposed and dried in the sun. Miss Margaret Lowe, to whom the discovery of Obolella in these shales is due, and who presented most of the specimens in the College museum at Malvern, found drying the shales by far the best plan of obtaining specimens of the Oleni,

which foreign collectors, especially, are always anxious to obtain.

The Obolellas and little Lingulas, or Lingulellas, which are found in the Holly Bush sandstones, and the black and grey shales, belong to that extensive group of animals, which are found both in salt waters and in fresh; the shell fish, or Mollusca, so-called from their soft bodies, which are protected by a shell. These animals are divided into classes—Cephalopoda, Gasteropoda, Pteropoda, Brachiopoda, and Lamellibranchiata—which differ very much from each other in points of structure and mode of life. They form an important history in the planet's economy now, and have done so for myriads of ages, for vast masses of rocks are almost entirely made up of fossil shells, which secreted their shells from the waters in which they lived. The Brachiopoda (arm-footed shells) are bivalve shell fish, which are lower in the scale of organisation than are the common mussels, cockles, and oysters, and they differ from them in being always equal sided, and never quite equivalve.* They were very abundant in ancient seas, and swarm in the older strata of the globe, but comparatively few forms have existed on to present times. It was formerly supposed that the Lingula was the first created form of organic life; but the discovery of the Eozoon in the Laurentian rocks, and a number of Trilobites and other animals in the Lower Cambrians, have upset this theory for several years. More than a thousand extinct species of Brachiopoda have been described, and of which the Obolella of the Malvern Shales is one of the

* Every geologist should make a point of possessing Woodward's "Manual of the Mollusca," "Recent and Fossil Shells." Virtue & Co., Ivy Lane.

oldest. In Russia this ancient shell forms the hard basis of a series of rocks ranging over a wide area. The Lingula Flags, which lie below the Tremadoc Slates of North Wales, are so-called from the number of shells of this little brachiopod which are found in the slates and shales of this formation of the Lower Cambrians in North Wales. The living Lingula is found in the seas of the Philippines, Australia, Feejees, and Sandwich Islands.

In the hedge row of the Coal hill field the Black Shales may be seen traversed by the decomposing trap rocks which form the bosses a little to the westward, and in some places the shales are roasted white by its influence. Fossils have not been obliterated altogether by this roasting, for we have found Oleni and Agnostus in the bleached shales. Here, probably, we have volcanic rocks of separate ages, and an outburst of trap through the Black Shales of later date than that trap which is evidently interbedded with them. This interbedding may be seen by descending the hill to a little cottage below the woods at the bottom of Coal Hill, where there is a section in the cider house attached to the cottage. These interbedded volcanic bands show how volcanic action was rife during the deposition of the Black Shales. The igneous interbedded mass, was probably, as already indicated, erupted from the vent of the Ragged Stone and Midsummer Hills. The lavas that are erupted *through the shales* I believe to be of later date than those of the cottage, which are interstratified.

Grey Shales—Dictyonema Beds.—Some years ago I was so fortunate as to discover that pale grey shales, containing Dictyonema, overlie the Black

Shales of the southern Malverns. There is no section, and to any but the lover of physical geology the correlation of these beds with those below them is not easy to see. The best place to see their position is half-a-mile south of the cottage alluded to, and on the south-western base of Chase End hill. They are exposed on edge in a water-worn ditch, close to a gate which leads from the lane to Bromesberrow Place. Here I found the *Dictyonema sociale*, which is very characteristic of rocks occupying the same geological position in North Wales and sometimes covers large slabs with its peculiar net-like structure.

Sir Roderick Murchison says that *Dictyonema* is a form "between the *Fenestellidæ* and *Graptolites*."* Some naturalists suppose these fossils to belong to the Bryozoa (moss-like animals) now classed at the base of the mollusca although once thought to be forms of polyps. Such are *Flustra* and *Retopora*, bryozoa which were formerly included with the corals. With the *Dictyonema* is found on the flanks of the Chase End a small *Lingulella*, but it is very rare. Fossils such as *Oleni*, *Graptolites*, *Dictyonema*, are used by foreign geologists as marking distinct zones. Thus in Sweden there are "*Olenus* schists," "*Graptolitic* schists," and "*Dictyonema* schists," and in Russia, "*Obolus* grits" cover large areas of country. We may also mention that it was the discovery of the *Dictyonema* shales at the Chase End, and their position to the black shales which enabled the author to determine the age of an upcast of rocks near Brampton Bryan in Herefordshire, when first taken to them by Mr. Lightbody, of Ludlow.

It is well, too, for a geologist resident at Malvern to make himself thoroughly acquainted with even such

* "*Siluria*," 4th Ed., p. 46.

pigmy sections as are displayed among these Upper Cambrians of the south Malverns, for pigmy no doubt they are. But it is wonderful how interesting geology becomes when you see rock sections displayed, as you may behold on the coasts of South Wales, near St. David's; and knock out with your own hammer a huge Paradoxides which lies in situ in the mud in which it was buried, after you have worked hard for Oleni in a ditch with two square yards of rock to work on.

It is not alone for their geology that the southern hills of the range are sought by naturalists. For the botanist they have their treasures, as recorded by our old friends and associates, Mr. Edwin Lees and the Rev. J. Thompson, of Cradley. Mr. Lees, the Worcestershire botanist, tells us in his various works* of the wild flowers of the Malverns and the country all around, how in May the hawthorns and mountain ashes, with the verdant holly, wave along the Holly Bush in milk-white purity, while in autumn pendant coral berries give another phase of beauty to the diversified scene. How, too, here grow in masses the fox-glove, the great mullein, and the wild thyme, and a "spread of lichens of a siller grey." In these woods of the Gullet, the Holly Bush, and Ragged Stone, the lover of birds hears in the spring-time the warbling of the nightingale among the trees; and in the autumn sees the ring ouzel feeding on the coral berries of the mountain ash. The hawfinch is not uncommon, and sometimes nests in the bushes, while the stonechat and wheatear perch upon the golden furze, and lay their blue eggs beneath it. Here, too, in the glens and among the trees of East-

* "Botany of the Malvern Hills," "Pictures of Nature," "Botany of Worcestershire," &c., by Edwin Lees.

nor Park the entomologist finds specimens of lepidoptera the collector would travel miles to possess. Mr. Edwards, of Abbey Terrace, at Great Malvern, has a large cabinet filled with beautiful specimens of the lepidoptera of the surrounding country. Among them are several specimens of that rare butterfly, the Purple Emperor (*apatura iris*), taken in the neighbourhood of the south Malverns, while I have often seen good captures of the Greyling (*hipparchia semele*), and the Great Fritillary (*argynnis paphia*) from the Gullet Pass, the gorge east of Midsummer Camp, and the summit of the hills.

The British Caer on Midsummer Hill is remarkable for the encircling earthworks which include the space on the summit of Holly Bush Hill, as well as the spur of the Midsummer crest. Like other British Caers it is adapted to the form and ledges of the ground. It protects the Holly Bush Pass, as that of the Herefordshire Beacon guards that of the Wind's Point. Worcestershire archæologists believe that there are remains of British dwellings on the eastern slopes of the Holly Bush, and Mr. Lines with Mr. Edwin Lees think there are traces of Danish occupation in the names of certain places around, as Ravenshill. Mr. Burgess has suggested that the name "Midsummer," which is given to the higher ridge on which are the traces of beacon fires, may have arisen with the Beltane fires which are still lighted on Midsummer Eve in Ireland. The scenery around these southern hills is very beautiful. Northward rises the boldest view of the Great Camp. Southwards on a fine day we can see from the Ragged Stone the Quarntock Hills of Somerset and the waters of the broad Severn glisten in the sun as they wind below Berkeley Castle, the place selected for the

murder of Edward II. Indeed, all around and before us are sites full of historic lore.

Higher up the Severn is the *Caer Gloew* of the Britons and the Roman *Glevum* (Gloucester), with its noble Cathedral beneath the hill of Robin's Wood, a city notable through all historic times; the residence of the Confessor, and often the court of several of the Norman Kings. Between Gloucester and Worcester there arose abbeys, priories, and Norman churches, notwithstanding that much of the Vale of Worcester was dense forest in Norman times. Here William the Conqueror and William Rufus passed their Christmas and hunted the red deer and the wild boar in the Forest of Dean. Here was crowned Henry III., and here commenced in 1263 the Wars of the Barons. Here the hero of Agincourt held a parliament, and hard by its cathedral close, in the time of Queen Mary, arose the smoke of Bishop Hooper's martyrdom, which must have been visible from these hills. Within its cathedral walls rest the bones of Strongbow; the tomb of that victim of a brother's cruelty, Robert of Normandy; the murdered King Edward II; the honest judge, Judge Powell; and many a worthy of older times.

Still higher up the Severn is the old church of Deerhurst, in which, facing the Malverns and the setting sun, is the memorial window to Hugh Strickland, "the tribute of many friends." It was to Deerhurst that Sweyn came up the Severn when avenging the death of his sister Gunhilda and the massacre of his countrymen. He burnt the church and drove its Prior for refuge to the forest around Great Malvern. Here, too, it is most probable that the

meeting of Canute and Ironsides took place when they divided the kingdom between them.

Higher up the Severn still we see the venerable tower of Tewkesbury Abbey, where was a Saxon church, the burial place of the murdered Brictric. Much of the Norman work of Robert Fitz-Hamon, one of the Conqueror's knights, is still standing, and so is the Norman nave. Here are the graves of the DeClares, and among them that of the Red Earl, who caused the trench to be dug which is so well marked along the summit of the Ragged Stone, and passes right through the British encampment on the Midsummer. Here, too, lies his son, the last of his race, who died in the prime of manhood at Bannockburn. Here are the graves of the DeSpensers, and among them the mutilated corpse of him who perished so miserably at Hereford, through his loyalty to his king. Here lies Guy de Brian, the standard-bearer at Crecy and Poitiers, and one of the first Knights of the Garter.

Here lie the bones of many of those Barons who fought and lost the great battle of Tewkesbury round the wooded hill westward of the Abbey (Tewkesbury Park); and the graves of Edward, Prince of Wales; the "haughty Somerset;" Wenlock, Clifton, and many another Lancastrian. Here, too, hard by the chancel, are the tombs of "false, fleeting, perjured Clarence," and his wife, "the Lady Isabel," the daughter of that maker and setter-up of kings, "renowned Warwick." Then a little on this side the Severn are Bushley and Paines Place, the "powre place," where in all probability Queen Margaret took refuge the night of the slaughter at Tewkesbury, and Pull Court, once the residence of Bishop Bonner. Then dotted about, in the eastern vale, are relics of

Norman churches, which were built in ingie nooks, by streams and rivers in the great forests which then swept far and wide over the vales of Gloucester and of Worcester. Such are Longdon and Pendock, Berrow, Birtsmorton and Eldersfield, Castle Morton, and Bromesberrow. Of all these there are records, some of Saxon, all of Norman times, and in each are still some relics of Norman architecture.

Southward, and nearer to the hill fortress of Midsummer Caer, is the Camp of Gadbury (Eldersfield); the old British dyke or trench at Pendock; and the Roman pass of Pendock Portway. When the Romans held Caer Gloew and Ostorius occupied the ridges of the Cotswolds, we may well believe that the Britons held Gadbury, and at the same time occupied the caer on the Midsummer. More to the westward and almost under the Chase End, we see the tall firs now growing above Haffield, the home of an English gentleman, Dr. Henry, the friend of science and those who love her paths.

Haffield was a British caer which defended the trackway between Gloucester and Hereford, and was, as remarked by Mr. Albert Way, within easy communication of Gadbury Camp on the south-east, and Wall Hills, above Ledbury, on the north. Nestling upon hills with wooded slopes is the beautiful church of Eastnor, built of Old Red Sandstone, and the ancient site of Castleditch, probably in olden times a Norman keep or ancient manor house, well defended by moats and water. Here were settled the relations of Lord Somers, that great statesman who, with Judge Powell, so stoutly defended the seven bishops whom the tyrant James sent to the Tower, and who drew up the "Declaration of Rights" for William of Orange and "Good Queen Mary." The

modern castle of Eastnor rises proudly above the old Castleditch, and the Eastnor Obelisk was built in memory of a gallant soldier who fell at the siege of Burgos.

Below the Obelisk are the ruins of Branshill Castle. Judging from an old engraving by Buck (date 1731) of this ancient stronghold, it would seem probable that Branshill, with its flanking towers and circular loopholes, must have been built in Norman times. It was probably somewhat like in structure to the Norman stronghold of Penvensey, which was erected in the days of William Rufus, within the old Roman walls of Anderida. The occupiers of Branshill would command the road or trackway by the Holly Bush Pass from Tewkesbury into Herefordshire. There is nothing left of it save a few mouldering walls and a fosse, but we may be well assured that many an episode worthy of record, now lost for ever, has been enacted in and around its walls.

The Ragged Stone Hill, which rises on the west of the Holly Bush Pass, takes its name from the cleft appearance of the hill when looking at it from the Chase end on the south; and this it owes to the weathering of a soft micaceous schist, which may be seen in the great quarry. Those who have paid much attention to the rocks of the Ragged Stone and Midsummer hills look upon them as the roots of an ancient volcano, which, in long ago geological ages (Upper Cambrian), poured forth its lavas into seas of the Cambrian epoch. That volcanic outbursts were also shot forth into the air, is evident from the appearance of certain layers of volcanic ashes, which were no doubt erupted before they fell into the surrounding sea. Weird, too, are the legends of the Ragged Stone, connected as they are with old tales

of human loves and sorrows, of sudden deaths, and broken hearts.

Some of these may have arisen when the great camp on the Midsummer Hill to the north was occupied by British warriors, or later, when the Saxons fled for refuge to the shelter of the Malvern forests after the massacre of the Danes by Ethelred, and the bloody reprisals which followed when Sweyn came up the Severn with his war fleet, burnt Deerhurst Church, and forced its Prior to take refuge in the dense forests which then swept far and wide around the hills. I have never been able to trace from the legend *when* the curse which followed the shadow of the Ragged Stone was pronounced from its cloven summit; but its shadow seems to have been for ages a terror to the surrounding inhabitants whenever its dark column was observed hanging over the forest, on those summer days when to dwellers in the vale the sun seems to set behind it. Perhaps the legends have something to do with the fires on the hill of Midsummer, or the traditions of the Danewort and the blood of the slaughtered Danes. At all events, its long shadow, which is sometimes seen as black as ink in the evening sunshine, has long been an omen, to those who have beheld it, of sorrows to come. More than once its warning has been given to those who lived in olden times at the old Manor House of Morton Court. There are few places in all Worcestershire more interesting than Morton Court and Birtsmorton Church. The church has lately been well restored, not mangled, through the exertions of my old friend, the rector (Rev. R. Pilson), and is full of interest in all its associations. The court, hard by, was no doubt in Norman times, a Norman keep, with its

moat and drawbridge. In later times it became one of the earlier manor houses. Before this alteration in the building, we have good reason to believe that it was a resting place and a hiding place for Sir John Oldcastle when he was hunted to the death. Sir John was somehow or other connected with Morton Court and its inhabitants, for the tradition of his hiding there was handed down through the Nanfans, who lived there in succession for centuries. A very old and revered lady, who was much at Morton Court nearly a hundred years ago, Mrs. Webb, of Ledbury, now in her 101st year, well remembers that she was frightened as a child, when showed the hiding place of Sir John, in the panelled room. It seems that Sir John Oldcastle made his escape from the Tower of London through the aid of his own chaplain, Thomas Payne, who was himself a Lollard. For several years they lay hidden in the forests and among the houses of their friends, notwithstanding that they were denounced at every market cross, and high prices set on their heads.

Later on Sir Giles Nanfan, who was governor of Calais, in the days of Henry VII., received Thomas Wolsey, then in his youth, as his private chaplain. Bishop Fox recommended him to Henry VII., and, says an Episcopal historian, "he so far pleased the king, that in a short time he became a great man." A prouder priest never stepped; but he might have learned a warning from the Shadow of the Ragged Stone, viz., that a shadow ever falls on those who put their trust in man rather than in God.

Later on, after the Battle of Worcester, where the Nanfans fought for the king, there was a Sir Giles Nanfan who was at the court of Charles II., and who brought a brother officer and friend to feasting and

merrymaking at Morton Court. One evening in the gloaming the shadow was seen creeping across that field of death, "The Bloody Meadow," near the Hawthorns, and the next day Giles Nanfan ran his best friend and his sister's lover through the heart. Once a year there is, or should be, a sermon preached on "The bloody sin of duelling," at the church of the Berrow, where the victim was buried: for Bridget Nanfan left "The Bloody Meadow" to furnish money for the preacher and for widowed women.

It is said, too, that "The Dark Maiden of the Marsh" would wander from the old timbered house of Eastington and watch in summer evenings for the shade of the Ragged Stone falling across the vale. It is a sad tale, that of Catherine Berkeley! A father falsely accusing her lover of sheep stealing—the innocent man hounded as a criminal to the gallows; the conscience-stricken false accuser; the mad daughter. No wonder the shadow fell!

CHAPTER II.

Lower Silurians of Wales—Cader Idris—Caer Caradoc—Sir R. Murchison—Fossils of Lower Silurians—Glacier Tracks—Alpine Plants—Builth—Salter on Middle Silurians—Conglomerate of the Llandovery: At North Hill; At The Wyche; At Cowley Park—Cowley Oak—Stricklandinia Beds near The Wyche—In the Malvern Tunnel in a Fissure; At Wind's Point—Sketch by Mrs. Walter Burrow—Little Malvern Church and Court—Old Glass—MSS. of Habington of Hendlip—Camp on Herefordshire Beacon—Old Coins there—Pass of the Gullet and Fossils near—May Hill Beds in Eastnor Park—Pterygotus found by Mr. John Burrow—Howler's Heath—Edible Fungi—View from Bromesberrow Church—Wild Plants—Newent—Dymock—Kempley—Swinyard Hill—Fair Oaks—Debris from the Coombe—Castle Morton—Woolhope Limestone—Stanner Rocks—Woolhope Beds at Cowley Park; in Malvern Tunnel—Dr. Grindrod's Museum at Malvern—Ballard's Quarry—Large Trilobites in Woolhope Beds—Trilobites' Eyes—King Crabs—Wenlock Strata: At Colwall Copse; Winnings Quarry; Near Eastnor Lodge; At the Ridgeway, Eastnor Park; Beyond Eastnor Castle; faulted in Ledbury Tunnel; Quarries at Ledbury—Clincher's Mill—Foley Arms (Tarrington), and Sir Roderick's Room—Peculiar Geology of the Woolhope District—Scenery from Seager Hill and Adam's Rocks—Dormington Wood and Fossils—Fossil and Living Corals—Hagley and Shuckley Hill—Landslips: In the Woolhope District; At Adam's Rocks, near Dormington—The Wonder—Butterflies at a Slip at Buildwas in 1763.

SILURIAN ROCKS OF THE MALVERN DISTRICT.

LOWER SILURIANS WANTING.

THERE is a very important series of Rocks in our Geological Ladder which are altogether wanting in the Malvern country. We have no Lower Cambrians with their great trilobite, Paradoxides, and our Upper Cambrians, with their small Oleni, show signs of repeated dislocations with upthrows on the eastern side,

and downthrows on the western, while both the Holly Bush sandstones and the black fossiliferous shales are traversed by masses of intruded igneous rocks. These igneous rocks between Midsummer Hill and the Obelisk Hill, and the Ragged Stone and Howler's Heath, occupy the position which in North Wales is filled by the *Lower Silurian masses* and their numerous fossils, and where they are seen to overlie the Upper Cambrians (Tremadoc beds) with their *oleni* and *dictyonema*.

There is then in the Malvern district a great hiatus in the geological succession which is filled in North Wales, and in the country round the Longmynd by Lower Silurians, and the reason no doubt is the elevation above the seas of the Malvern axis, after the deposition of the Upper Cambrians; while, as will be seen, this land was again submerged during the period when the *Upper Silurian sea beds* were laid down and were washed into crevices and fissures of the old syenitic gneiss. The volcanic rocks, then, which occupy the low ground between the south Malverns and the base of Howler's Heath and Obelisk Hills, occupy the position of the Lower Silurians, which include the great Llandeilo or Arenig, and Caradoc or Bala formations—formations which, in Europe and America, as well as in Great Britain, are of the greatest importance to geologists, in determining the life of the periods they represent, in the ladder of geologic time.

In North Wales, Professor Sedgwick long ago showed how rocks of the Lower Llandeilo series were traversed and intermingled by sheets of volcanic rocks, and how these strata, full of fossils, and yet interbedded with outbursts and sheets of lavas, were afterwards elevated into mountains and curved into

undulations. Such are the hills of Cader Idris, the Arans, the Arenigs, and the Manods. Cader Idris itself is a remnant of the roots of an ancient volcano which was active in Lower Silurian ages. Snowdon was a volcano in Caradoc times. The Caradoc rocks were named by Sir R. Murchison after the old British encampment of *Caer Caradoc*, which is visible from the Malverns, and which were deposited in the seas when volcanic action was rife where now rise the noble Snowdonian mountains, and the hill of *Caer Caradoc* by the Longmynd. A glance at "The Student's Elements of Geology" will tell the beginner what beautiful fossils are found in the Lower Silurian strata, and perhaps tempt him to ramble among the rocks of North Wales; the slopes of the Stiper Stones, and *Caer Caradoc*; the hills near *Builth*; or the old town of *Llandeilo* on the *Towy*, by the haunts of *Merlin*.* Twenty-three genera of trilobites and 111 species are found in the *Caradoc* strata, and with these are beautiful starfishes, and some singular animals between the crinoids and echinoderms (cystideæ), while the *Llandeilo* flags furnish graptolites in vast abundance, and trilobites of wonderful dimensions (*Asaphus tyrannus*), which with cephalopods and other mollusca lived in myriads in Lower Silurian seas.

Nor is it for fossils only that we recommend the Geologist the investigation of the rocks which belong to the Lower Silurian epoch whether volcanic or sedimentary. There are old glacier tracks at *Cader Idris* and at *Snowdon*, which are as well defined as those around *Chamounix*! Among them the Author and his old friend and companion for more than a quarter of a century, Sir Wm. Guise,

* "Records of the Rocks," p. 99 (Murray).

have gathered alpine plants such as the *Saussurea* and the *Silene acaulis*, the relics of an Alpine flora, which grew when glaciers filled Llyn Idwal or swept below the Glyder. Again, at Builth, there are the igneous rocks of the Carneddau; and trilobites and graptolites in the stratified beds of the Llandeilo seas; with ruined Castles, the silver Wye and the big boulders of a glacial stream.*

The Lower Silurian rocks, however, are not represented in the Malvern district. As already described, there appears to have been an outburst of volcanic materials towards the close of the Cambrian epoch, and the space between the Upper Cambrians (the Holly Bush beds and the Black Shales) is occupied by masses of igneous rocks which range over and along the position of the Lower Silurians and which, as far as we can see, for there are no sections, are overlaid unconformably by the Upper Llandovery beds or the basement strata of the Upper Silurians. No traces of Llandeilo or Caradoc strata have been found along the Malverns.

THE MAY HILL ROCKS (UPPER LLANDOVERY).

Mr. Salter, who was for many years palæontologist to the School of Mines, was of opinion that the Lower Llandovery strata, so called from the town of Llandovery, in South Wales, with the May Hill (Upper Llandovery) series, should constitute a group of "Middle Silurians."† This is not, however, the opinion of Mr. Etheridge, or Professor McKenny-Hughes, who now occupies the chair of Sedgwick at Cambridge. The Lower Llandovery series are supposed

* "Records of the Rocks." † "Records of the Rocks." p. 120.

to be wanting at Malvern, as are the Lower Silurians, while the May Hill beds (Upper Llandovery) are well defined and certainly constitute the base of the Upper Silurian strata in the Malvern country. In the Llandovery district Professor Hughes assures me that the Lower Llandovery series are unconformable to the Lower Silurians, but conformable to the May Hill beds.

Conglomerate of the Llandovery and May Hill Beds.—The lowest beds of this series are represented by a kind of breccia well known to geologists as "Miss Phillips's Conglomerate;" but a conglomerate proper is a cemented gravel bed with rounded pebbles, whereas the rock alluded to is made up of *angular* fragments of the Malvern syenitic axis with a few Llandovery fossils, bound together by a cement of iron oxides. It is therefore more a *breccia* than a conglomerate. This breccia was named in honour of the discoverer, Miss Phillips, sister of Professor Phillips, and may be seen along several points of the Malvern range as an ancient beach, still clinging, as it were, to the old syenitic axis.

Along the northern Malverns this breccia has been found resting against the western side of the North Hill, and dipping at a high angle from the plutonic axis. In it is a very characteristic fossil of the Llandovery series, *Petraia bina*, and fragments of that large shell *Stricklandinia*. *Petraia bina* is a coral, and looks like the cast of a grooved child's thimble. *Stricklandinia* is a fossil brachiopod, formerly called pentamerus, and is very conspicuous in the slabs of purple and grey sandstones which overlie the breccia. The breccia may be seen to the north of the Wyche Pass, on the flanks of a great quarry

between The Wyche and West Malvern, and again on the western side of The Wyche itself. In Cowley Park it rests against the trap outbursts; and it has been found resting against the quarry of Holly Bush sandstone on the north side of the Ragged Stone, and also against the syenitic axis of the Midsummer Hill. This sea beach should not be confounded with the Cambrian conglomerate at the base of the Holly Bush beds of the south Malverns.

Mr. Lees draws attention to the "Cowley Oak," which he considers as more than 600 years old.* If so, this tree was standing, a goodly tree, when Queen Elizabeth went there hunting, from Worcester, and shot stags with her own cross-bow. "Cowley's Oke" is referred to in a MSS. survey of Malvern Chase, 1633.

Stricklandinia Beds.—These rocks are important to the lover of physical geology, as showing another subsidence of the Malvern range, north as well as south, during the period of the deposition of the May Hill rocks; and the lower strata which contain the *Stricklandinia* have assisted us wonderfully in our conclusions. There is a new house a little north of The Wyche, and nearly on the same level as the entrance to the cutting through the rocks! I have to thank Mrs. Devas, of Colwall, for directing my attention to the fact that the foundations of this house were excavated in grey and purple shales and sandy beds, which are preserved in a hollow in the syenitic axis, and which are full of this fine fossil, which is abundant at Llandovery, in the Lower Llandovery strata, and is characteristic of our lowest May Hill beds, of Malvern, whenever we can

* "The forest and chase of Malvern".—Transactions Malvern Field Club, p. 63.

catch a sight of them *in situ*, which is not often. These fossils may be seen in the collection of Mrs. Devas, at The Quarry, Colwall.

Another important locality, where these beds were discovered, was in the middle of the Malvern Tunnel.

It was evident to the members of the Malvern Field Club, who examined the history of this remarkable discovery, that a mass of mud and shales, with shells then living in the sea, had been washed into a fissure of the old gneiss of the axis by the waters of the sea which then rolled over the site of the house near the Wyche and the hill of the railway tunnel. So dark was the centre of the tunnel from whence these old muds and shales were taken that it was impossible to see by candle light of what they consisted. When *Stricklandinia* was seen well preserved in the shales a hearty cheer welcomed the discovery.*

Another locality showing the remarkable preservation of these rocks, containing *Stricklandinia*, was near *The Wind's Point*, where they may still be seen resting against the Syenitic axis behind the house belonging to Colonel Peyton, known as "Johnson's house." Here they contain, in addition, *Pentamerus oblongus*, *Petraia bina*, and *Atypa reticularis*. Much of the rock containing fossils was carted away, but there is a good sketch of the section by Mrs. Walter Burrow, at the Museum at Malvern College. From the pass of the Wind's Point another fossiliferous mass of these strata was removed by Mr. Johnson, from the road side opposite the little Inn.

On the east side of the Wind's Point, near the base of the hills, are the little church and picturesque

* See "Quarterly Journal," Geological Society, p. 13 (May, 1861), and "Siluria," 4th Ed., p. 97.

ruins of Little Malvern, which every stranger should visit. Hard by is the old Court, the residence for many years of the Beringtons, surrounded by beautiful trees and scenery. Antiquarians tell us (Dugdale and Nash) that there was a church and small priory, or house of Benedictines, founded here as early as 1171. It was an offspring of the Benedictine establishment at Worcester, and was built to extend religion in the wilds of Malvern Chase. Some portions at the entrance of the present church look like relics of the Norman period, but the perpendicular east window tells of the times of the Wars of the Roses and the days of Edward IV. Mr. Albert Way met with a tradition, that the glass in the east window was placed there to commemorate the great victory at Mortimer's Cross (1461), before Edward was king. He led his victorious army from Hereford, where he executed Owen Tudor, "the father of a race of kings to be," by Ledbury and the Wind's Point to Worcester. However this may be, the glass was not placed there until 1482, when John Alcock, Bishop of Worcester, rebuilt Little Malvern. The glass is now much mutilated, and all that remains are two vertical panes, which represent the Prince of Wales, to whom Alcock was tutor, in his twelfth year (born 1470); but the crown on the head of this Prince (Edward V.) looks as if the window could not have been introduced in the time of his father. The head attire is the same as that of Anne, queen of Richard III., in the Warwick or Rouse Roll. The subject of the window lights are Elizabeth, Cecily, Anne, and Katherine, daughters of Edward IV. Fortunately, a detailed description of the glass when still perfect has been preserved among the MSS. of Thomas Habingdon, of Hindlip (born 1560), who was

concerned in the Gunpowder Plot, and was sentenced not to leave the county of Worcestershire. He thus became the county historian, and the authority from which Dr. Nash drew so much of his information. Habingdon says: "In the east window of the Quayre consystinge of six lofty panes, theare is paynted in the middest and worthiest of them Edward the fourthe in a robe of Ermynes wearinge his ryghetfull imperiall crowne, yet purchased anewe with divers blouddy battles, and in the next pane his Queen. In the pane behind the kinge was his eldest sonne the Prynce, after Edward the fyfthe" . . . "and in the last pane of that syde his brother Richard Duke of Yorke." "In the pane behind the Queen was theyre eldest daughter the Lady Elizabeth behind her systers."*

Above the Wind's Point rises, on the left, the fine camp on the Herefordshire Beacon. It was about A.D. 50 that Ostorius Scapula marched against the Silures, and no antiquarian who realises the fact that both he and Aulus Plautius before him occupied the Cotswolds and the left bank of the Severn, can doubt that the British patriot Caractacus must have held this caer before he had to retreat step by step and fight his last battle on the slopes of the Breiddens, or on that great British caer above Knighton and the Teme. The Romans no doubt occupied it afterwards, for Roman relics have been found there, and my friend Mr. Stone, of Chambers Court, had several Roman coins which were found on the very summit of the caer, and which were left there when it became a Roman camp. The adjoining eminence to the west was a hill of beacon fires, and the rocks below are charred with the heat.

The next locality where the Upper Llandovery or

* *Archæological Journal*, vol. 22, p. 302.

May Hill rocks may be seen, in close proximity to the syenitic axis, is near the entrance to the valley which leads to the Gullet and Fair Oaks. Coming up the pass from the east, and turning through the gate to the right hand, there is a section by the side of the lane which leads through a wood to Swinyard Hill. These are higher in the series than are the Stricklandini beds, as may be seen at Howler's Heath. *Lingula parallela* is a common fossil here, and is often flattened. It has also a metallic look. With this we have *Orthis biloba*, a *Rhynchonella*, and some fossil Conchifera, or bivalve shells, which are more or less allied to the oysters and scallops of the present seas. Such are *Ctenodonta*, *Eastnori* and two *Pterineas* which are found in these strata near the summit of the Gullet pass. *Orthis* is an old world form of Brachipod, which, like *Trilobites*, does not pass upwards beyond the Carboniferous rocks. Four species of living *Rhynchonellidæ* are known while more than 300 are known as fossils. The *Pterineas* are bivalves allied to the modern pearl oysters or wing shells (*Avicula*), and range from the Lower Silurians to the Carboniferous rocks. In the casts of the *Ctenodonta Eastnori* we often see the impression of the teeth of the hinge. These May Hill beds may be seen all along the path which skirts below the Obelisk Hill and above Bransil. Above Bransil there are some old quarries well worthy of an hour's hammering.

There is a beautiful hillside and woodland scene along Eastnor Park where it faces the Midsomer Hill, and a small section in the May Hill rocks nearly opposite the gate which leads to the footpath to the Ledbury road is very fossiliferous, and full of

* "Student's Elements of Geology," p. 632 (3rd Ed.)

the shells just alluded to. In the quarry beyond, my friend, Mr. John Burrow, of Great Malvern, found the swimming foot of a *Pterygotus*, a crustacean allied to the king crab. This specimen is unique, as no relics of this animal have been found elsewhere in strata so old as the May Hill strata. Its discovery is recorded by Sir R. Murchison and Sir William Jardine.*

The geologist should ascend the hill to the Obelisk above, as from thence he will obtain a good view of Howler's Heath, and May Hill in the distance to the south-west. May Hill gives its name, in this district, as proposed by Professor Sedgwick, to these Upper Llandovery rocks which were mistaken for Caradoc or Bala beds by Sir R. Murchison. May Hill, nevertheless, is not so good for sections as Malvern, and that is not saying much. It is a prolongation of the great Silurian upthrow from Woolhope, which is also well seen from the Obelisk, to Purton Passage and Tortworth across the Severn, the neighbourhood of which may be distinguished, with the aid of field-glasses.

Howler's Heath may be said to belong to the Malvern district, and some of the May Hill strata there are fossiliferous when quarried, which is only on rare occasions. The best plan for the geologist who wishes to follow out these strata on their strike, is to cross Eastnor Park westward, to a quarry near the Ledbury road, on the left-hand going to Eastnor, and not far from the lodge to Bransil. Here the purple grits furnish *Lingulas* and other fossils, but they are not so abundant as below the Obelisk. Near the summit of the green common on Howler's

* "*Siluria*," p. 96; "*Memoirs of Hugh Strickland*," p. 257.

Heath, and to the south, is a quarry in purple grits, where may be found that fine *Lingula*, *L. crumena*. These grits are overlaid more to the south and west by the *Stricklandinia* beds, which are now, unluckily, not exposed, save in thin bands in the wood below. On sinking a well for a cottage on the edge of the wood these beds were exposed, and my friend the Rev. R. P. Hill obtained large slabs of stone covered with *Stricklandinia*, *Pentameri*, and other fossils which are abundant in these rocks at Llandovery. Howler's Heath is a fine wild hill, and both the platform of gorse and the surrounding woods are famous for their Fungi in the autumn. *Agaricus procerus*, so good for the table, grows here in abundance; so does *Prunulus*, the fairy ring *Champignon*, Puff Balls (*Lycoperdon*), and the *Chantarelle*, all delicious eating.

The view from Howler's Heath, far and near, embraces much of interest. The beautiful church of Bromesberrow, rebuilt by our friend and companion for many years, the Rev. R. P. Hill, with its ancient yew trees and avenue of elms, and banners which were borne at the battle of Worcester, is close by, and alone demands a visit. Then Bromesberrow is the home of rare plants, the nodding Star of Bethlehem (*Ornithogalum nutans*); the sweet scented daffodil (*Narcissus poeticus*); and the tower mustard (*turritis glabra*); while there are many other points of interest to be mentioned, in their proper place, as belonging to the Bunter sandstone rather than "the hoar rocks of the hills."

Beyond Bromesberrow rise the ridges of Redmarley, with its mill of Saxon site and woodlands which were woodlands in the time of the Confessor. Then there is beautiful Hazeldine and Bury Mill,

with traditions of George Shipside, Bishop Ridley's "dear brother," before he faced the stake at Oxford. Beyond is Newent, the stronghold of fox hunters from Edwardian times to the present; for in the days of Bishop Swinfield, the Prior of Newent was termed, "The Foxhunter."* We see Dymock, too, the birth-place of the Man of Ross, and The Grange with its records of the days of Henry IV. and Richard II.; while on the borders of the old forest of Dymock and Newent is the little Norman Church of Kempley, with its ancient wall-paintings of Norman times executed by Norman hands. These and many other points of interest may be seen from "The Howling Heath," which in its days of wilderness was no doubt a refuge, in the forests themselves, for those who, like the Prior of Deerhurst, or Oldcastle and Payne, had to search for the least frequented places and the darkest woods.

On the western flanks of Howler's Heath the geologist will find a Permian rock (Haffield breccia) dipping away from the upheaved masses of May Hill strata, of which the basement beds appear to be red or rather purple grits with *Lingula crumena* and grey flags with *Stricklandinia*. These pass upwards into purplish shales containing Wenlock fossils, and which, as far as we can judge, are conformable to the Woolhope shales and limestone which may be seen in position at the base of Howler's Heath Hill on the west, where a small section is exhibited above the Clincher's Mill Brook opposite the mill. The lowest strata of the Llandovery or May Hill series contain *Pentamerus liratus*, but they are unsatisfactory deposits, being hidden in swampy hollows and difficult to find. They occur above a small quarry

* "Swinfield Roll." Camden Society.

of Woolhope limestone at the entrance of the valley of Netherton, on walking upwards towards the Obelisk, where the *Pentamerus liratus* shales dip under the limestone and as far as we can see at a conformable dip. The dislocation these rocks have undergone by the earth movements along the Malvern chain may be understood by the fact that, although on the western side they are still to be seen, with their fossils, high up near the Wyche at the Wind's Point, above the Holly Bush beds on the Midsummer, and at the summit of the Obelisk Hill and Howler's Heath, they are thrown down on the east in the gorge between the Gullet and the Fair Oaks. Fragments of these beds are found in the beds of debris opposite the Gullet and Swinyard Hill, and it is evident from their position that they have been washed down the coombs to the bases of the hills. We have seen large angular slabs with fossils as low down as the road to Malvern. The Swinyard Hill was called by Professor Phillips the "Silurian Pass," because a saddle of Silurian limestone may be seen on the east and west slopes of the pass between the hills. The term Swinyard is derived from the fact of the dwellers round the forests being allowed by the "Red Earl" to pasture their swine with acorns along this ridge. The Wenlock beds, as well as the Llandovery strata, have been seen still clinging to the eastern slopes of the Swinyard, a proof that there was a time when the crest of this hill was once washed over by the waters of the Wenlock seas. Wenlock corals have been found, beneath the debris, in the garden of the cottage on the slope of the hill above the road to the Gullet quarry, and it is evident that the same rocks are somewhere *in situ* in the Gullet pass itself from the occurrence of Wenlock fossils in the debris on

Castle Morton Common and below the Fair Oaks.

The Fair Oaks is now the name of a farm situated at the eastern entrance to the Gullet pass. It is in a picturesque situation, and in front are smiling fields of corn, while at the back is the gorge between the hills and the beautiful woods that clothe the slopes. Tradition tells us, however, that it was not always so, but that poachers and deer hunters were at one time kept in awe by a gallows that swung among the oaks and which was frequently in request. The wilds around Castle Morton were in those days frequented by a lawless set of men, who slew the Red Earl's deer whenever they had the chance. There are relics of a Norman church at Castle Morton, in the southern doorway, and the remains of a moat and a Norman keep. The archæologist who could find some records of this old castle and its history would supply some of the many missing links respecting this ancient parish under the Swinyard Hill.

WOOLHOPE LIMESTONE OR LOWER WENLOCK ROCKS.

These strata are developed in some very picturesque districts far better than along the Malvern ranges, where they are much hidden. We must search from place to place in the Malvern country to understand their correlation with the Wenlock shales above them and the Pentamerus lirus shales below them. From the crests of the Malverns we can see the Radnor Hills, and recommend the geologist to visit the picturesque rocks of Stanner, near Kington, where grow some of the rarest plants in Great Britain (*Scleranthus perennis* and *Lychnis viscaria*), and where the Woolhope

Limestone is traversed and altered by the igneous eruptions of Stanner and Worsel, and then see the equivalent limestones where they circle round the dome of Haughwood, and its May Hall strata, in the Woolhope country itself beyond the hills of Ledbury. He will then have no difficulty in recognising the position of these strata westward of the Malverns, and how distinct the Woolhope limestone is from that of the Wenlock limestones above them.

In the neighbourhood of Great Malvern the nearest section is at Cowley Park, where Professor Phillips described them and the faulted condition of the rocks. They appear in the section already alluded to near Cowley Park Farm. Perhaps the lover of physical geology may see their position better by observing their shales and calcareous bands in the green pathway which leads from the Wyche down to the Wenlock quarries called Winnings. Here the Woolhope beds may be traced passing into the May Hill series which rest against the syenitic axis; and there, too, may be seen how they are succeeded by the Wenlock shales and limestone—the shales in the vales, the limestone in crests and low hills. The excavations for the tunnel between Malvern and Ledbury showed the Woolhope strata deposited in an excavated bay or coomb in the Malvern axis. The May Hill beds (Upper Llandovery) were, as we have already seen, washed into a fissure in the metamorphic rocks in the centre of the tunnel, but outside the syenitic axis they were seen “resting perpendicularly against the external wall of syenite full of fossils.” *

The Llandovery beds were, as far as we could see, conformable with the Woolhope series, and

* Author's Paper, “Quart. Journ. Geol. Soc.,” May 1861.

Pentamerus liratus was found near the top of the Llandovery series, and numerous Trilobites and other Wenlock fossils in the Woolhope beds. The excavations supplied a splendid collection of fossils to the museum of Dr. Grindrod, at Townshend House, Great Malvern, who is always most courteous and kind in showing his unrivalled collection to all true lovers of the hammer. Some years ago a quarry was worked in the Woolhope limestone near Hawkset Copse, but it is now closed. The geologist may nevertheless see how its position differs from that of the Wenlock limestone, in resting against the May Hill group without any intervening valley in excavated shales. This quarry was known as "Ballard's quarry." I have to thank Mr. Ballard himself for much help and kindness, especially when engaged in examining the difficult history of the Malvern drifts. The other localities I recommend are sections already alluded to, viz., on the slope of Howler's Heath, near the Glynch Brook at Clincher's Mill, and in Eastnor Park at the entrance of the Netherton valley. Its course, too, is well marked about Storridge, along the western slope of Mullin's Copse.

Those who visit the Museum of the College at Malvern will see some fine specimens of *Illænus Barriensis* and *Homalonotus Knightii*, which were found by the author at Scuterdine in the Woolhope valley. Both of these fine trilobites are more abundant in the Woolhope shales and limestone than in the Wenlock rocks above. Years ago we saw the shales at Corton quarries, near Presteign, charged with the remains of *Illænus*. So also at Scuterdine, near Mordiford, these are the prevailing trilobites, whereas *Asaphus caudatus* is more characteristic of the Wenlock beds. The *Homalonotus* must in some

instances have exceeded a foot in length. The eyes of some trilobites are beautifully preserved in many specimens from the Wenlock strata. In some instances 400 spherical lenses have been detected, and of them Dr. Buckland remarked that we find "in the trilobites of the early rocks the same modification of the organ of sight as in the living crustacea; in those remote epochs the marine animals were furnished with instruments of vision in which the minute optical adaptations were the same as those which now impart the perception of light to the living crustacea. The mutual relations of light to the eye, and of the eye to light, were therefore the same at the time when crustacea first existed in the bottom of the primeval seas as at the present moment." The king crabs of the Molluccas are perhaps the nearest living analogues to trilobites. These crustacea have compound eyes and sometimes attain the length of two feet. Their shells are used for lading water, and their bodies for feeding pigs. Their eggs are eaten in China. They are a wandering race of crustacea, and inhabit shallow seas.

WENLOCK SHALE AND WENLOCK LIMESTONE.

The Wenlock Shale and Wenlock limestone overlie the strata we have just alluded to. They take their name from the well-known district of Wenlock Edge in Shropshire,* where the hard limestone extends for miles, an escarpment of rock, and the soft shales are denuded and form a vale. So in the Malvern district the limestone occupies low hills, the shales are denuded into valleys and slopes.

* The explorer of Silurian geology should possess Sir R. Murchison's "Siluria", (Murray).

There are many localities where these strata may be studied to advantage, as they range from Suckley on the north to Clincher's Mill south of Eastnor and Ledbury. Indeed no group of rocks in the Upper Silurian series of the Malvern district can be more easily traced than the Wenlock limestone. Colwall Copse and Winnings Quarry can easily be reached from Malvern, while Purlieu Lane is a favourite spot for those who search for fossils. Winnings Quarry, when worked, was famous for *Orbiculas*, many of which may be seen in the College Museum, and with these are found numerous corals (*Heliolites*, &c.), Crinoids or stone lilies, and many fossil shells. The *Orbiculas* (*Discina*) were horny, limpet-like brachiopoda, with a disk. The existing *Discinidæ* are all tropical shells.

The Woolhope and Wenlock beds may be seen near the lodge on the Ledbury road, *en route* to Eastnor Castle, resting against the syenitic axis of the Camp Hill. The beautiful drive called the Ridgeway is a crest of Wenlock limestone, and the valley on the left, or Netherton valley, is in the Wenlock Shales; that on the right (Ockeridge) is in the Lower Ludlows.

Netherton slopes when first ploughed yield many *Atrypas* and some *Trilobites*. There are quarries on the right of the Ridgeway near the road leading down to Ockeridge; and one in Eastnor Park, near the entrance from the Tewkesbury road where characteristic shells, such as *Strophomena*, are abundant. Beyond the gardens at Eastnor Castle, on the road to Clincher's Mill, there is a good quarry very fossiliferous and furnishing the brachiopods *Atrypa*, *Strophomena*, and *Orthis*; with several Gastropods, such as *Euomphalus* and *Murchisonia*; and

bivalves, as *Modiolopsis* and *Orthonota*; with many tails of the common trilobite *Asaphus caudatus*. I secured from here a magnificent coral (*Stromatopora*), now in the possession of my friend Dr. Wright, of Cheitenham, and a very perfect *Phacops caudatus*, now in the College Museum. The little trilobite *Phacops Downingiæ* which is found here in the shales and also at Netherton, is generally rolled up like a wood-louse, or hedgehog, with its tail and mouth in close proximity. The lover of physical geology will be struck, on visiting the Ledbury district from the Ridgeway, with the way in which the Aymestry rocks and the Wenlock strata are crumpled and repeated, rolled in short. Standing on the crest of the Ridgeway for the first time he will be surprised to learn that the Wenlock limestone of that wooded crest is repeated in the Ledbury tunnel, where it was thrown down into a nearly horizontal position; also that the Aymestry beds and the Upper Ludlow series, reappear in the hill called Chance's Pitch, west of Ockeridge; while the crest above the rifle target beyond the Somers Arms, is Upper Ludlow rock which rises again in Dog Hill, above Ledbury and Bradlow.

●

The Ledbury quarries in the Wenlock limestone are a good deal worked for lime and roadstone, so they have furnished a number of beautiful specimens to the hammer of Mr. Piper, who is a resident there and well acquainted with geologic lore. Henry Brooks, a shoemaker living in the town, has done much for the investigation of the rocks of the neighbourhood, while the science of geology is indebted to him for his close watching of the tunnel excavations, and the discovery of some of the most remarkable fossils, which will be elsewhere alluded to.

There are few more beautiful walks than is the path from Ledbury to Eastnor over the Wenlock limestone, and few more inviting village hostels for a roaming geologist to stay at than the Somers Arms, from whence excursions can be made to the most interesting sections, amidst the lovely scenery of the Park and its environs. Clincher's Mill Wood should not be neglected, as famous for its wild flowers ; and the stained appearance of the Wenlock rocks on the south side, where they are often red and purple, owing to their having been overlaid by the red and purple breccia known as Haffield breccia (Permian beds). On the eastern side of this wood, between Clincher's Mill and Eastnor, is a quarry of drift, which yielded the remains of the Mammoth in the upper beds, while the basement is composed of large angular masses of local erratics which must have been stranded there by ice. Beyond Clincher's Mill, on the road to Bromesberrow, the Haffield breccia and Bunter beds (Bromesberrow sandstone) may be seen. Indeed the neighbourhood of Eastnor and the Somers Arms furnishes an amount of geologic investigation ranging from the Plutonic and Laurentian rocks, the Upper Cambrians, and the Upper Silurians, to the New Red Sandstone of Bromesberrow, which I do not know elsewhere, within the compass of a morning's walk.

The geologist who visits the Eastnor and Ledbury country should also spend a few days in examining some of the most remarkable geologic phenomena, as regards the Upper Silurians, in Great Britain, viz., the celebrated valley, or rather series of valleys, round Woolhope, a peculiar, out-of-the-way district to the west of the high road between Ledbury and Hereford. The train takes you in twenty minutes from the Ledbury Station to that of Stoke Edith, and

a short walk conducts you to the Foley Arms, where I can only repeat "make yourself comfortable in Sir Roderick's room," for this country inn will ever be to the geologist classic ground as connected especially with the labours and investigations of Sir R. Murchison, when engaged in writing his "Silurian System." "Rest assured that a week may be spent at that village hostelry in examining the geology of that remarkable district, and enjoying picturesque and peculiar scenery without fear or hazard of *ennui*."* The railway and high road to Hereford both run near the base of Seager Hill, Stoke Edith Park, Adam's Rocks, and Backbury Camp, which bound the celebrated Woolhope "Valley of elevation," but not one traveller in ten thousand is aware of the beauty and the extraordinary character of the scenery as seen from Seager Hill or Adam's Rocks. Nor is it in a day or two that the geologist will be able to comprehend the phenomena of upheaval, dislocation, and wonderful denudation represented in that area.

The Woolhope district may be briefly described as an elongated pear-shaped mass of Upper Silurian rocks, from the May Hill (Llandovery) strata to the Upper Ludlow series inclusive, which were elevated through the overlying Old Red Sandstone which circles round, and were then denuded and washed away down to the May Hill beds, which are found, with their fossils, on the summit of the dome of the great wood called Haughwood. Walking from the station of Stoke Edith, which is on the lower Old Red, we pass a little beyond the church at Tarrington to the Passage Rocks and Downton Beds, where my friend, the Rev. P. B. Brodie, found some of the rarer

* "Old Stones" (1st Ed.).

crustacea appertaining to these strata (*Eurypterus Broderi*). Above these, westward of the park fencing, are quarries in the Upper Ludlow shales, with many characteristic fossils, while the crest of the hill, which runs in a kind of semicircle from near Marcle, by Seager Hill, to Backbury Camp above Dormington, is the hard Aymestry rock. Looking from this crest westwards the geologist beholds a strange scene of basin-like formation, which is caused by the excavation and denudation of the Wenlock and Lower Ludlow shales. Low wooded hills of Wenlock limestone circle round the Haughwood Dome, the Aymestry rock again appearing across the basin and rising above the Wenlock crests.

Here, then, we have illustration how earth movements have elevated the Silurian rocks *en masse* through an area of overlying Old Red Sandstone and shales; for Wall Hills, and the country around Bosbury and west of Ledbury, all tell of the persistence of the Lower Old Red rocks over surfaces where now rise Silurian elevations. The best localities for fossils, in the Woolhope district, may be said to be Scuterdine, near Mordiford, for Woolhope limestone fossils, and large trilobites, which the quarry men often preserve. Dormington Wood is rich in Wenlock corals, and there are many shells, some of which, as the *Strophomena euglypha*, are beautifully tinged with a metallic glow of purple. Several kinds of coral may be collected even now among the spoil heaps, though the last time the Malvern Field Club visited this fine section the limekilns were abandoned. We cannot gather these fossil corals on a summer's day in the bright sunshine, surrounded by overhanging hills and green English woodlands, without thinking of the wonder-

as in the church at Quatford, and in many of the churches in the south of France. The Caen stone of Normandy was brought to England in early Norman times, and the tower of Tewkesbury was built of French coralline limestone, every stone of which must have been brought up the Severn.

There are many other points of interest in the valley of Woolhope or round its outskirts, to which we only allude briefly. Such are the trap dyke at Hagley, to the north, which is erupted into and metamorphoses the lower Old Red Sandstone; and the hill of Shuckley, which is like Woolhope itself, an upthrow of Silurian rocks. Then there is the old landslip of Adam's Rocks, where the Lower Ludlow shales have slipped into the valley; and below these, on the way to Dormington quarries from Adam's Rocks, are Lower Ludlow fossils, Graptolites, and Lingulas in fair abundance. Then there is a great landslip in the Upper Ludlow shales, opposite Claston, between Dormington and Stoke Edith. Lastly there is "The Wonder" at Putley, and relics of the Romans, collected by Mr. Riley, at Putley Court. "The Wonder" was a landslip of the days of Queen Elizabeth (1575), described by Camden as due to "That kind of earthquake which naturalists call *Brasmatia*." It is also recorded in Drayton's "Pollyolbion." It was a slip in the Upper Ludlow shales like that just alluded to, but it buried a church, of which the bell has been found. It is recorded of a landslip on the Severn (1783), near Buildwas Abbey, that people picked up "the impressions of a flying insect, not unlike a butterfly." No doubt "The Wonder" also furnished hosts of "butterflies," in the tails of trilobites, which were then precipitated into the vale.

CHAPTER III.

Ludlow Rocks and Passage Beds—Reasons for Grouping by Sir R. Murchison—Ludlow District—Lower Ludlow Shales in the Malvern District; Brockhill; Faulted in Malvern Tunnel; in Ockeridge Valley; at Ledbury Tunnel—Graptolites rare around Malvern—at Adam's Rocks in Valley of Woolhope—Cephalopods, description of—Orthoceras—Nautilus—Phragmoceras in Lower Ludlow—Lituites—Star-fishes at Leintwardine—Scaphaspis, in Lower Ludlow, the first known Fish—Trilobites, and where to find them—Aymestry Limestone—The Rev. T. T. Lewis—His Photograph at Woolhope Club Room—British Camp at Croft Ambrey—Battle Field of Mortimer's Cross—Owen Tudor's burial place—Chance's Pitch near Herefordshire Beacon—Aymestry Rock in Malvern District—Encrinites; Cystideans; Lingula Lewisii—Aymestry and Wenlock Boulders stranded by Ice—Upper Ludlow Shales and Passage Beds—Brockhill and the Rev. Mr. Dyson—Bone Beds: Transition Epochs—Bone Beds of the Upper Ludlow, and the summit of Old Red Sandstone—Rhætic Bone Bed—Bone Bed at Hales End, Cradley—First known Fishes and their Allies—Gamage Ford and Bone Bed—Supposed Silurian Land Plant—Wilcroft and River Drifts—Quarry in Passage Beds at Hagley, Lugwardine—Pterygotus and Fossils there—Volcanic Dyke at Bartestree—Passage Beds in Ledbury Tunnel—Lingula Cornes—Ledbury Shales—The Fish, Auchenaspis, in Grey Grits—Fossil Fishes in Passage Beds—Old Ledbury—Norman Relics in Ledbury Church; St. Catherine's Chapel; Market—Bishop Swinfield—Battle of Ledbury—Great Marcle.

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abundant in the Lower Silurians, where they have the teeth or serræ on two sides, whereas the Upper Silurian forms have the teeth only on one side. Ninety species of these animals occur in the Llandeilo and Arenig beds of Wales and Scotland. Sir William Jardine had a large collection of them from near Moffat, in Dumfriesshire, and Professor Harkness described many forms which in some are so numerous as to render the shales quite "coaly" or anthracitic. In such swarms did Graptolites live in the muds of the Llandeilo seas. The brachiopods of the Lower Ludlow series are Wenlock forms, and so are the corals, which, however, are not nearly so abundant. There are, however, certain cephalopods, such as Phragmoceras, which are almost typical of these strata. Cephalopods are a class of the mollusca, or shell fish, which from their high organisation stand at the head of the order. The Pearly Nautilus, Argonaut, Cuttle-fish, and Calamary are examples of living cephalopods, so called from their having feet or arms attached to their head, as the cuttle-fishes. Some of the cuttle-fish still living are colossal, with arms long enough and powerful enough to pull down a large boat. The Argonaut has been the theme of many a poem, ancient and modern, while the Pearly Nautilus, of which the empty shell is well known, is most difficult to obtain living.

The living Nautili, of which three or four species are known, inhabit tropical seas. An elaborate engraving of the animal in its shell, after the description by Professor Owen, faces the title page of Woodward's "Manual of the Mollusca." It is said that in the East Indian Archipelago the natives dive for them in about two fathoms, at low tide, and bring them up, for food, alive. This is at Rotti-Rotti. Mr.

Bickmore, an American naturalist, had, nevertheless, the greatest difficulty in obtaining a living specimen of the Pearly Nautilus until one was taken off a coral reef in a kind of eel basket of bamboo.* These animals have beautiful shells, large eyes, an organ for hearing, mouths surrounded by fleshy arms, which they also use as legs. With these arms, which are furnished with innumerable nerves, they can seize their prey and fix themselves to anything they wish to hold on by. They have jaws somewhat like the mandibles of a bird, a brain, and remarkable respiratory organs, with a siphon, or pumping apparatus, by means of which they are enabled to ascend to the surface or sink to the bottom of the sea. No wonder, then, when we consider the difference between such highly organised animals and an oyster, or a brachiopod, that these molluscs should be at the head of their order, and rank next to fishes, to some of which they may be considered as superior, making them their prey. The cuttle-fish walk head downwards, and the calamary darts into the air with a stroke from its tail.

Such are the animals to which the extinct fossil forms, such as the *Orthoceras* (*orthos*, straight; *ceras*, a horn), *Phragmoceras* (*phragmos*, a partition), and *Lituities* (*lituus*, a trumpet), are closely allied as are also the Ammonites of the secondary rocks, which for unnumbered ages were the denizens of seas long ago become continents. More than 250 species of *Orthoceras* are known, and they range from the Cambrian deposits into the Carboniferous; while the various forms of *Nautilus* appear to commence in the Lower Silurians, and range up to present times. Nearly 200 species of *Nautili* are known as fossils,

* Bickmore's "Travels in the East Indian Archipelago."

ancient crustacean is straight, and sometimes rolled into a ball. "Rum fishing it must have been in them waters, sir," remarked a countryman to me when I showed him specimens of these crustaceans from the banks of the Teme.

AYMESTRY LIMESTONE.

This limestone rock takes its name from the beautiful village of Aymestry, near Leominster, which was for many years the abode of the Rev. T. T. Lewis, who discovered the geological position of the Upper Silurian rocks, collected many of their typical fossils and communicated his knowledge to Sir R. Murchison. This was followed by the publication of the "Silurian System," a work to which Sir Roderick owed much of his well-earned fame of a geologist, for it gave to the world the history of some of those ancient rocks which had long gone by the universal name of "greywacke," a name which in those days was applied generally to any class of rocks in Scotland or Wales, of which the geologist knew nothing.

A photograph of the geologist of Aymestry may be seen in the room of the Woolhope Club, at the Free Library at Hereford, and below it the following acknowledgment of his discoveries from the pen of one of the most distinguished living Naturalists :—

"He discovered and classified the series of strata to which the term 'Upper Silurian' was afterwards applied."

Aymestry is situated on the Lugg, and is within reach of the great British Caer above Knighton, supposed by some to be the last stronghold of Caractacus. Above it rises the British Caer of Croft Ambrey, a hill of Aymestry Limestone. Hard

by also is the battle field of Mortimer's Cross, where (1461) the Earl of March (Edward IV.) defeated the followers of Henry VI., under Owen and Jasper Tudor, husband and son of Catherine of France widow of the hero of Agincourt. Owen Tudor was beheaded at Hereford, and his body was buried at the White Friars, close to Wye Bridge.

The Aymestry rock of the Malvern District is well marked by its wooded crests, which stand out boldly, in many localities, as a border of the Silurian rocks of Malvern and Ledbury. The undulations of the country, however, are so great, that although conspicuous enough in the hills above Hales End, at Brockhill and Rilbury, west of the Malvern axis, it is difficult to trace in all its windings and faultings, as in the example of Chance's Pitch, close against the Malverns, and again above Hope End, above the Old Red of Colwall. The Aymestry rock, westward of the North Malverns, is not the same solid limestone, charged with that fine shell *Pentamerus Knightii*, that it is in the Ludlow and Aymestry districts. It consists of hard calcareous nodules, with thin bands of limestone and beds of shales. In the neighbourhood of North Malvern, too, it is less fossiliferous than near Ledbury; and everywhere the *Pentamerus galeatus*, already mentioned as entering in abundance into the Niagara limestone, seems to take the place of *Pentamerus Knightii*, which in the Ledbury, Woolhope, and Malvern districts, is very rare and dwarfed. *Strophomena depressa* is abundant at Evendine, and the high-crested hill marks well the difference of position, as compared with the Wenlock limestone at Winnings quarry, Colwall copse, and Croft limekilns. The physical geology of these strata, and their relation to the

from the nearest Silurian deposits; and the Keuper (New Red) platform of the camp is covered with Silurian angular drifts. It is impossible to account for the transportation of these masses of Silurian rock, mostly sharp and angular, without the agency of floating ice which stranded and, when melting, dropped the erratics in the rounded gravel (northern drift) in which at Haffield and at Hartbury they were found embedded.

UPPER LUDLOW SHALES AND PASSAGE BEDS.

In the Malvern district, as in other localities in Siluria, the Upper Ludlow Shales are those which rest on the outer rim of the Aymestry beds, and dip away under the Old Red Sandstone. There are no fossils in the lower portions of these shales which are not common to the rocks below them, but the upper shales, which pass into the "transition" or passage rocks, are very important, and to these we beg for especial attention.

Mr. Salter, the well-known palæontologist, was a great deal at Malvern during the latter part of his lifetime, and wrote a paper for our "Malvern Transactions" upon the bone bed at Brockhill, which is remarkable for its "true passage," says Mr. Salter, "from the uppermost Silurian into the base of the Devonian system."*

Brockhill is easily reached from Malvern, and its investigation was carried out by the Rev. F. Dyson, who, as long as he lived, was indefatigable in his exertions to elucidate the intricate geology of the surrounding neighbourhood. He spent a considerable sum in clearing the section at Brockhill, and

* "Transactions of Malvern Field Club," 1855.

succeeded in showing the true Upper Ludlow rock, with *Strophomena depressa*, *Chonetes lata*, and *Rhynchonella nucula*, all characteristic fossils. Above these came the *Bone Bed*.

But what is a "*Bone Bed*"? A bone bed probably owes its origin to the sudden destruction of fish and other animals by submarine volcanic action, gaseous emanations, and the introduction of melted lavas, into the waters of the sea, and which proved fatal to those which were within the range of the deleterious agent. A bone bed is often found to be persistent over large areas, and sometimes the relics contained in it look as if they had been drifted by currents for some distance, being intermingled with sandy layers. The kinds of animals imbedded vary in different localities. Thus near Ludlow the bone bed has been called "the beetle bed," from the black shining appearance of the numerous fragments of small fish and crustaceans, while near Stokesay it looks brown like linseed oil cake. At Hagley, Lugwardine in Herefordshire, and Gamage Ford near Marcle, the remains of fish and crustacea occur in about equal proportions; while at Pyrton Passage on the Severn fish bones and rounded pebbles lie in a sandy drift. At Brockhill, near Malvern, the bone bed furnished few remains of fish compared with that at Ludlow, but the relics of the Silurian lobster, *Pterygotus*, were interbedded with a small *lingula*. In existing seas the distribution of marine animals is very different along different coasts and vary still more at different depths. Crustacea are often abundant where fish are comparatively few, and *vice versa*. An outburst of sulphureous gases or lava into the seas round the Dogger Bank would cover the sea bed with the dead bodies of myriads of

marine animals and especially fish. Captain Parsons, of the ship Harbinger, described to our brother naturalist Mr. Jones, then the Austrian Consul at Gloucester, how he sailed for several hundred miles through shoals of dead garfish (*Sygnathus anguineus*) "so that it was hardly possible to pull up a ship's bucket without catching four or five dead garfish."* These dead fish were most numerous in those latitudes through which the volcanic line of Iceland, the Azores, the Canaries, and Madeira passes. Had this destruction happened in a shallow estuary, or on a shallow coast line, there would have been some of the circumstances adopted for the formation of a bone bed. We must not, however, forget that most of the bone beds in the records of geology occur at, what may be termed, *Transition epochs*. That is to say they form horizons when, as regards life systems, *a great change took place*. There is a great deal of mystery as yet belonging to these phenomena. They do not represent merely local destruction on a great scale. What brings them just at those transition periods in the planet's history, when numerous forms of life pass away in the records of the rocks never to be renewed? The bone bed of the Upper Ludlow rocks is very close upon that horizon where Silurian life is lost for ever. The same may be said of the bone bed at the summit of the Devonian rocks, which occurs at the junction of the lowest Carboniferous shales with the Upper Old Red; or that of the Trias (the rhætic bone bed), which has yielded the earliest form of mammalian life, but which occupies a remarkable boundary line between the life of the Triassic epochs, and that of the great Jurassic

* Edinburgh New Phil. Journal.

formations which rest above. Another locality for the Ludlow bone bed is at Hales End, Cradley. Here there is an instructive section showing the Ludlow rock full of chonetes, orbiculas, and smashed serpulites, which must not be set down as fish bones. The fish bed itself, with the defensive spine of *Onchus Murchisoni*, is seen in the hillock behind the coachhouse of Hales End House. Both at Brockhill and at Hales End it is overlaid by the yellowish Downton sandstone, which contains a few lingering relics of Silurian shells, such as *Trochus helicites*, and *Lingula cornea*, and if well searched, may yield remains of that first known form of fish, *Scaphaspis*. Until the discovery of that specimen, already alluded to in the Lower Ludlow of Leintwardine, the fishes of the Upper Ludlow, were supposed to be the most ancient representatives of vertebrate life. They have lost this honour of the antiquity of fishes; but who knows how long the *Scaphaspis* of the Lower Ludlow will hold it? Among living plants and animals it is almost hopeless in our British Isles, to expect to behold any new and undescribed form. It is not so in geology! There is not a formation in all England, where by some stroke of the hammer, the searcher may not hope to lay open some form of life which human eyes have as yet never gazed on.

What then were these early fishes like? When we are told that one is allied to the sturgeon (*Accipenser*), we think of that great fish which sometimes attains the length of eighteen feet and a weight of 500 pounds in the Volga, and of which smaller specimens are taken in our own rivers, whose roe we eat as caviare, and consume its air-bladder as isinglass. Such certainly was not the *Scaphaspis*,

or any of the Pteraspidean fishes, as regards size, although they were covered like the sturgeon with plates instead of scales like ordinary fishes. Again, we are accustomed to think of sharks as associated with gigantic size and power, growing to a length of 30 feet, and possessed of great teeth and prodigious strength. So we are surprised when we are told that small fish like the possessors of the spines known as *Onchus*, and the shagreen of *Thelodus*, were fish allied to the existing shark. Such, however, is the opinion of our most distinguished ichthyologists, such as Sir Philip Egerton, Lankester, Huxley, Day, and others. Fish spines, the remains of these tiny predecessors to the great sharks, have been found at Hales End and Brockhill, but we have not as yet recorded the plates of *Pteraspis* from either of these localities. The way to reach one of the best localities for the Ludlow bone bed, within reach of Malvern, is to take train to Ledbury, and to proceed to the Walwyn Arms, at Great Marcle. A walk from thence to Gamage Ford will show the bone bed to the north of the Ross and Ledbury high road, at a place between Lyne Down and Gamage Ford. The bone bed crops out on the side of the lane. The author was present at the discovery of those curious round pellets named *Pachytheca*, which were discovered by the Rev. Henry Stone, in 1851, and sent by Mr. Hugh Strickland to Sir Joseph Hooker for examination. For many years the *Pachytheca* was believed to be the seeds of a land plant allied to the *Lycopodium* or club mosses; but a further examination, under the microscope, of sections of these pellets has induced Sir J. Hooker to recall his former opinion, and he now believes that these seeds belong to seaweeds and not to land plants. Another

locality at Marcle, known to the Ledbury geologists, furnished some very perfect plates of *Pteraspis* or *Scaphaspis*, and spines of *Orchus*, now in the museums of the Earl of Enniskillen and Dr. Grindrod. Another expedition, within reach of Malvern, for one who would enjoy a "crack at a bone bed," is to take the rail at Malvern or Ledbury for Lugwardine Station, four miles from Hereford. First let him examine the remarkable section of old river drift in the ground below Wilcroft, and within ten minutes' walk from the station. Boulders, a ton weight, of Caradoc conglomerate from the north were found here, and with them masses from the Clee Hill basalt. A tooth of rhinoceros and several of horse were found in the gravel, and the pebbles are seen to be arranged by river action, by those who know the difference between a river gravel and the beach of a sea or lake. Passing on to the village of Lugwardine, let the explorer ask his way to the old quarry, perhaps he had better say "ould quar," in the grounds of Hagley. The section is much grown over now, but when it was first opened there was exhibited a remarkable dome of Upper Ludlow rock with the bone bed and Downton sandstone elevated through the surrounding Old Red rocks of Lugwardine. Here, in 1852, Mr. Mackay Scobie found the swimming feet of the *Pterygotus problematicus* now in the cabinet of Mrs. Hugh Strickland. This was the first discovery of the limbs of this crustacean.* From Hagley, at different times, various specimens have gone forth of fish spines and fish coprolites, fragments of Silurian crustaceans, and here and there a portion of a plate of *Pteraspis*. The Bartestree Trap dyke is just above the Nunnery. It traverses and meta-

* Quart. Journ. Geol. Soc., Nov. 1852.

morphoses the lower Old Red Sandstone, and is a good example of a fissure caused by earthquake movements and then filled in by volcanic matter.

DOWNTON SANDSTONE AND PASSAGE BEDS.

"The Downton Sandstone," says Professor Phillips, "stands as a group of passage beds, the lower part allied to the Silurian and the upper part allied to the Old Red stratifications." Since Professor Phillips wrote, the excavations on the railways near Ludlow, and at Ledbury, have shown that the Passage Beds must be extended above the horizon of the Downton beds.

The Downton Sandstone takes its name from the beautiful ravine at Downton Castle, near Ludlow, the home of Andrew Knight, the great horticulturist and promoter of the culture of the apple and the pear. It is a fine-grained yellow sandstone, and is overlaid both at Ledbury and Ludlow by grey and red marls containing fish, and a few Lingulas, and these are again overlaid by the marls and cornstones of the Old Red proper. Nevertheless, when we pass the horizon of the bone bed and the Downton Sandstone we see no more the familiar forms of Silurian fossils. There are no more trilobites, no more numerous Silurian shells, but plates of ganoid fishes take their places, and the strata themselves begin to put on that colour from which the great Old Red formations take their name over large areas in the West of England and in Scotland. The Downton beds and some of the red and marly shales which were exposed within the western cuttings at Ledbury tunnel were seen at Brockhill during the excavations of Mr. Dyson. They occur also near Halls Court

and Hales End. They are partially seen overlying the Upper Ludlow rock along the hill where the rifle targets are placed between the Somers Arms and the Ockeridge Valley; and again, along the flanks of Bradlow, near Ledbury, and the ridge that was northward towards Hope End. They are, however, so little exposed in the Malvern and Ledbury districts that it is not worth while to waste time searching for these rare fossils in this neighbourhood.

I find on referring to my paper "On the Ledbury Tunnel,"* that the bone bed of the Upper Ludlow was not detected at Ledbury, but a note written after this paper was published records the finding of a *Pterygotus* on the horizon of the bone bed. The Downton beds were not well shown, but they were there, though faulted by "a lateral wrench from east to west." Mr. Collingwood and Henry Brooks found the characteristic *Lingula cornea* in these strata, and over these were a series of muddy marls, some of which were reddish; they were quite conformable with the Downton beds below. These marls and sandy beds contained a rather large *Lingula*, different from the *Lingula cornea*, and with these commence that important series of deposits termed by Mr. Salter "Ledbury shales," and which are really passage rocks passing into the lowest Old Red rocks above them. These strata were all within the entrance of the tunnel on the Ledbury side, and not far from the entrance the remains of *Pteraspis*, that earliest form of fish, was found by Brooks. As the sections within the tunnel had to be explored by the light of tallow dips, it may be supposed that critical examination was not carried on so easily as where

* *Quarterly Journal Geological Society*, May, 1880.

exposed to the light of the sun, which was the case as regards the succeeding strata of the Ledbury passage beds when seen in the railway section west of the tunnel mouth. And fortunate were those geologists who beheld that picturesque section under a summer's sunshine. They will in all probability never have the opportunity again of seeing these remarkable strata—these passage rocks, as they are generally masked.

Standing with our backs to Dog Hill, with Bradlow rising on the right, and the fine tower and spire of Ledbury Church on the left, grey grits and shales, with red marls at their base, and dipping at a high angle to the westwards, constituted the rocks at the entrance to the tunnel. These beds were a striking background to the series of purple shales and red marls and sandstones which succeeded them in ascending order, and stood out in bold relief, while the eye, looking onwards beyond the railway and its excavations, rested on the wooded slopes of the great Camp of Wall Hills and the eastern rim of the Silurian strata, which above Putley and Tarrington indicate the upheaval of the Woolhope rocks and their strange geology. The Old Red hills above Bosbury and Canon Frome tell their history by their colour, while the Leddon flows along a line of fault in the lower Old Red marls, which much mystifies the correlation of the Wall Hills rocks with the Ledbury shales and lowest Old Red marls. The grey shales and grits at the tunnel's mouth furnished the remains of a large Cephalaspis, a fish which will be alluded to more fully in the next chapter; and the pincer of the crustacean, *Pterygotus*, to the indefatigable hammer of Henry Brooks.

These Ledbury passage beds are now hidden from

our view, and it were vain to enter into more details, so I must refer my readers to the description of the section in the Quarterly Journal of the Geological Society (May 1860). Suffice it to say that we had in the railway section the equivalent strata of those described by Mr. Lightbody near the railway bridge at Ludlow. In a bluish grey rock Henry Brooks discovered a number of remains of the little fish named *Auchenaspis* by Sir P. Egerton, and which was found on the same horizon at Ludlow. The tail and body of this fish are as yet unknown, but as many as four heads have been found on one slab. In the the same rock were found portions of *Scaphaspis* or *Pteraspis*, *Cephalaspis*, and fish spines of some size (*Onchus*). Above these *Auchenaspis* grits were a series of red marls with pinkish coloured sandstones in which fossils were rare. *Pteraspis* and *Cephalaspis*, however, were found in them. A number of the fossils found in this railway cutting were sent to the Jermyn Street Museum. Among them was a nearly perfect specimen of "*Cephalaspis Murchisoni*"! obtained by my friend Mr. Walter Burrow from the grey grits, and also some Silurian shells, such as *lingula* and *Murchisonia*, passing as it were from the Silurian rocks towards the base of the Old Red.* What became of the fossils is unknown, but it is a pity they are unacknowledged and undescribed.

There are few towns situated in a more interesting locality for the geologist than Ledbury, while Old Ledbury has much to interest the archæologist. Within a walk are the British earthworks on Haf-field, Midsummer Hill, the Camp Hill or Herefordshire Beacon, and Wall Hills which Mr. Albert Way maintained was a British caer before it

* "*Malvern Transactions*."

was occupied, later on, by the Romans, of whom relics have been found, both on the Camp itself and near Putley Court. Herefordshire did not become part of the Saxon kingdom of Mercia until the time of "Offa the Terrible," and Offa built a church and bequeathed lands to the church of Hereford to expiate the murder of Ethelbert (760); while Camden and other old historians record that "Edwin, a powerful Saxon," gave Ledbury to the church of Hereford, imagining himself cured of the palsy by St. Ethelbert's prayers.

It was William Rufus who, after he was driven from Wales with great loss (1094-5), ordered the erection of a chain of castles and forts along the frontier. It is not improbable, therefore, that the erection of such castles as Branshill and Castle Morton may be of as early a date. At all events the remains of Norman architecture in Ledbury Church are not later than the time of Henry I. On the north side of the choir is an early corbel table and round clerestory splayed outwards, showing that this was once the outside of the original Norman church. The piers, too, of the nave were originally Norman, as is proved by a portion of the original curving being still visible on one of the capitols. They were altered and adapted to the decorated aisles which now surmount them. The north aisle is terminated by a beautiful early pointed window, of which there is a poor imitation on the south side. In the splendid decorated chapel of St. Catherine the windows are ornamented with the ball flower, similar to those in the south aisle of Gloucester Cathedral.

In 1140 we find King Stephen investing the castle of Hereford with a large army and afterwards sitting crowned in the cathedral during divine service. He

granted charters for markets to be held at Ledbury and Ross. In the time of Henry III., Bishop Hugh Foliot (1232) founded St. Catherine's Hospital at Ledbury. His portrait is at the canon's residence, with some account of his charities. It was, too, in Henry's reign that the dispute commenced respecting Bishop Cantilupe's (1275) and the Red Earl's claim to the chase of Eastnor and Colwall. Cantilupe and Bishop Swinfield both held ordinations in Ledbury Church. Bishop Swinfield lived in the time of Edward I. and Henry III., and brought back the heart and bones of Thomas de Cantilupe to Hereford from Rome. He appears to have been frequently resident at Ledbury as well as Bosbury. He was a lover of the chase and appears to have put the hounds out "at walk." He was careful of not offending the Red Earl, who had become son-in-law of the king, and so sent his hounds from Prestbury, near Cheltenham, round by Gloucester to Ledbury, rather than across the Severn fords through the chase of Malvern. The Swinfield Roll records, too, that there was a vineyard in Ledbury which yielded seven casks of "white wine" and nearly "one of verjuice."

The "Battle of Ledbury" was fought between two hundred cavalry under Prince Rupert and some Parliamentary troops under General Massey. The fight apparently took place between Ledbury and Haffield, on the Gloucester road, and it appears that Massey had a narrow escape, for Prince Rupert sought a personal encounter with him and shot his horse.* Great Marcle, too, which is also famous for its Ludlow bone beds, is well worthy of a visit for the

* "Historical introduction to *Bibliotheca Gloucesterensis*," Roll of the household expenses of Richard de Swinfield, Bishop of Hereford, 1288, 1290, *Cam. Soc.*

sake of its fine old church, so well restored under the auspices of the rector, (the Rev. Mr. Chatfield). Edward the 1st granted Much Marcle to Earl Mortimer, who built a castle there, and some of the Mortimers lie buried there

CHAPTER IV.

Old Red Sandstone and Devonian Rocks—Old Red supposed to be Freshwater Deposits—Devonian Rocks—Marine Deposits—Localities on the Old Red visible from the Malverns—Old Red Strata near to the Malverns—Lord's Hill near Colwall Station—Old Coast at Haffield; Overlaid by Carboniferous Rocks; Pierced by Silurian Rocks—Cradley Quarries—Fish Remains near, discovered by Mr. Gill—Professor Lankester on Old Red Fish—The Garpike—*Polypterus* and *Ceratodus*, Living Fishes Allied to Old Red Fishes—*Pteraspis* and *Cephalaspis*—Old Red Fishes at Trimpley; At Acton Beauchamp—Section on the Bromyard and Worcester Railway—Railway Cutting near Ledbury, below Wall Hills—Cornstones of Wall Hills—Font of Cornstone in Bosbury Church—Bishop Cantilupe's Champion—The Old Room at Crown Inn, Bosbury—Cornstone Hills near Hereford—Woolhope Club and Transactions—Free Library and Museum—Old Red Quarries and Fossil Fish near Leominster; Near Weobly—White Cross and "Black Death," Credenhill—Fossil Fish at Kentchurch Hill—Portrait of Owen Glendower—Brownstones of Old Red Sandstone—The Middle and Upper Old Red—Fish Described by Hugh Miller—Pencerrig Calch—Physical Changes—Llanthony Abbey—Transition Beds in Dean Forest—Symonds's Yat on the Wye—Vast Denudation of Old Red and Carboniferous Rocks—Geology of the Cleve Hills—Cleobury Mortimer, and Rare Fossil Fishes—William Longland—Historical Localities from the Worcestershire Beacon—Ancient British Remains: Saxon; Worcester: Danish; Norman, &c.—Battle of Evesham—The Rhydd Ford—Edward I. at Worcester; Owen Glendower, at; Prince Arthur buried, at—Bishop Bonner at Hanley Castle—Queen Elizabeth at Worcester—Lickey Hills, &c.—Old Hendlip—Battle of Edgehill—Battle of Worcester—Perry Wood—Pickersleigh—Hanley Castle.

THE OLD RED SANDSTONE AND DEVONIAN ROCKS.

"THE *Old Red*," as it is often briefly called, was so named originally, because its thick masses of stratified rocks are overlaid by the Carboniferous

rocks ; whereas the "*New Red*," overlies the carboniferous group. It was long ago advocated by a distinguished geologist, Mr. Godwin Austen, that the Old Red Sandstone may have been deposited in great fresh water lakes, over the Old Red areas of Scotland and England, and the term *Devonian* was proposed by, Murchison and Sedgwick, for masses of rocks containing marine shells and corals, and which in the south west of England, and on the continent, are generally considered to be the equivalents in time of the Old Red strata, in which marine organisms are so deficient. Mr. Etheridge informs us that we have no life species, connecting the two long periods of the Silurian and Devonian epochs, and none which connect the Devonian and Carboniferous epochs. We deal here only with the Old Red proper, which ranges over so large an area of country westward of the Malverns, and where there are quarries upon the mountains, and in deep glens by running brooks, with relics of those strange fish, of which Hugh Miller penned "*The Old Red Sandstone*,"* of which Dr. Buckland himself a most eminent geologist wrote, that he would give his left hand if he possessed his powers of description. Westward of the Malverns, too, are situated on the Old Red, old churches, ancient manor houses, historic battlefields, lore for the archæologist who loves to visit the works of man, while the geologist explores among the works of God.

The old British town of Aberhonddhu (Brecon), with its ancient castle, built by the Conqueror's follower, Bernard Newmarch, stands upon the Lower Old Red on the banks of the Usk, below those Beacon Vans, glimpses of which we catch from the

* "*The Old Red Sandstone*," by Hugh Miller.

Worcestershire Beacon, among the hills to the west. The Gobannium of Antoninus (Abergavenny) embosomed among the hills of the Scyrrid, the Sugar Loaf and the Bloreng, all seen plainly from the Malverns, stands upon rocks rich in fish remains of the Old Red lakes or seas. So does Monmouth, the birthplace of the hero of Agincourt! Grosmont, where he defeated the Welsh and took prisoner the brother of Owen Glyndwr, stands upon a hill of Old Red, above the Munnow, and the stones, in heaps by the roadside, often glisten with the plates of those "griesly fisch of the "laithlie flood." Nearer to the Malverns is the home of "The Man of Ross"; the "silver Wye" rolls below; and two miles to the south is ancient Ariconium, a Roman town, which was built upon the Old Red. The Henfordd (Hereford) of olden days is *the city* of the Old Red. Romans abode near unto it, with their Magna Castra (Kenchester) and their campon Credenhill (Cornstone), "before Herefort had a beginning." In Saxon times King Offa chose a hill of cornstone, close by, for his stronghold.*

Dynedor Camp, close to Hereford, on the south, said to have been occupied by Ostorius Scapula, is on Old Red; and so is the battlefield of Mortimer's Cross, to the westward, below the Silurian hills of Shobdon, all visible from Malvern hills. We can see the hills of Old Red which rise above Leominster, with its Norman church by the Arrow, which old Leland thought was built "afore the conquest." Then again Old Red is seen, nearer to us, in Bromyard Downs and the hills above Cradley, localities famous for fish relics, when you know where to find them, and where diligent search and a knowledge of the

* *Records of the Rocks*, p. 227.

grouping of the rocks will supply the heads, plates, and tails, and perchance a perfect specimen of Pteraspis, or Cephalaspis. Behind these, to the north, rises the bold outline of the Titterstone Clee, with its basalt and carboniferous rocks, traversed by igneous outbursts, and on its northern flank the yellow sandstones of Farlow, which belong to the *uppermost* Old Red, and contain the remains of *Holoptychius* and *Pterichthys*, which, as described by Hugh Miller, are like the columns of Tubal Cain.* These fish relics are like those two obelisks of brass, twin witnesses that certain fishes, abundant in the Upper Old Red of Scotland, lived and died within sight of the Malverns, and when the uppermost Old Red of the Vans of Brecon and Caermarthen were being deposited by the waters. The rocks they lie in have resisted the denudation which has been so vast over the Herefordshire and Monmouthshire areas, and are chronicles of masses of strata well nigh lost.

The geologist who would examine the nearest Old Red strata at Great Malvern, will find red clays and marls which cannot be mistaken ranging along the base of the hilly Ludlow rocks, and extending from thence far across the country, over a large area, through which are elevated the Woolhope Silurians and those of Shucknall Hill. These red strata may be seen, northwards, on the western slope of Suckley Hills, and Lord's Hill, and, nearer to the Malverns, at Hales End Farm and Mathon Lodge. Red marls appear near the Colwall Station. They skirt Hope End at Wellington's Heath, and flank the Silurians near Ledbury church. They formed an old coast line at Haffield, beyond Ledbury,

* "Old Red Sandstone," p. 191.

to the south, against which the old Permian beach was laid down ; and these *lowest* strata are covered by higher and higher beds, as we travel westward, until we find them overlaid by Carboniferous rocks on the hills of Dean Forest, or piled up to a thickness of 3,000 feet in the Vans of Brecon and Caermarthen. One of the first lessons in physical geology the student has to learn when exploring among the crests of the Silurian ridges, and then hammering at an Old Red quarry below, is that all the Old Red strata once covered up the Silurian rocks, as certainly as our present sea beds overlie rocks or sediments far beneath them.

The nearest locality to Malvern for Old Red fossils is on the Bromyard road beyond the great quarries on the high ground above Cradley. On crossing Cradley brook we cross the break between the bone bed and passage beds of Hales End, and the Old Red of the hill on the summit of which are the Cradley quarries. These quarries are higher in the series than those from which we obtain fossils, and Mr. Gill, who resides near, and has paid much attention to the geology of the district, has obtained but few remains, and these carbonaceous markings of plants, from the rocks on the hill. The horizon of fossil fishes is beyond the Cradley quarries, where the Old Red is denuded, and you descend into a vale towards Bromyard. Here, opposite an old timbered farmhouse, the lower Old Red was quarried for roadstone, and was found to be exactly like the beds at Leyster Sprowle, near Leominster, and like them, contained numerous plates of Old Red fish, and remains of plants, probably those of water weeds. The fish remains are surrounded sometimes by remains of plants, and knock out, under the hammer, like purple

oyster shells. The fish have been referred to Pteraspis, Cephalaspis, and Zenaspis, all Cephalaspidean fishes; but for the structure of these forms we must refer our readers to the important monograph of Professor Ray Lankester,* and the contributions of Agassiz, Egerton, and Huxley, on these Devonian fishes. It must suffice for our purpose to say that as the little spines of Onchus, &c., in the Ludlow bone bed belonged to fishes allied to the shark, so did the plates we find in the Old Red cover the bodies of a series of fish with *bony plates* like the sturgeon, while others were covered with *bony scales*, as in the existing Bonypike of the American lakes (Lepidosteus), or the Polypterus of the Nile. A great number of the Old Red fishes were of the Ganoid sub-order, so called from their shining scales. Of the shark and dogfish allies only spines and teeth have been preserved.

The Garpikes of tropical America grow large and are good eating. The geologist should make a point of seeing the specimens in the fish cabinets of the British Museum, in order to understand what their bony scales are like, and the way in which their heads are protected by plates. The Polypterus also has its head covered with sharpened bony plates and the body with strong ganoid scales. This fish is found in the Nile and other African rivers, and when boiled like lobster is good for food. Another living ganoid fish to be observed is the *Ceratodus* of Australia, described by Dr. Günther, of the British Museum.† It is a large fish of the fresh waters of Queensland, with a cartilaginous backbone and ganoid scales. My friend, Mr. Serocold, who has often eaten them, declares the flesh to be

* Palaeontological Society (Vol. 21). † Popular Science Review.

equal to that of Severn Salmon and quite as pink. From Dr. Günther's account it is a vegetable feeder, and takes a hook baited with a worm. In the Earl of Enniskillen's collection is a fine series of the teeth of fossil *Ceratodi*, from the Triassic bone bed at Aust Passage, near Bristol. They have also been found at Wainlode, near Gloucester; and Garden Cliff, near Newnham. The Lower Old Red strata, alluded to near Cradley, afford the plates of *Scaphaspis Lloydii* in some abundance, and it was here that Mr. Gill obtained a specimen which enabled Professor Lankester to describe the scales of the *Pteraspis*; only the head plates being known before.

Here also Mr. Gill found a nearly perfect specimen of *Cephalaspis Lyellii*, now in the museum of Dr. Grindrod. This specimen travelled to Belfast to the meeting of the British Association, and was examined there by the most distinguished ichthyologists now living. From some grey beds in this quarry, full of the remains of plants, Mr. Dyson obtained what are believed to be the eggs of the crustacean, *Pterygotus*, (*Parka decipiens*). Hugh Miller describes in his own language the "Seraphim" of the Scotch quarrymen, and how Agassiz declared the scattered relics to be "the remains of a huge lobster." An excellent restoration of this lobster is given in Lyell's "Student's Elements" (p. 443). These crustacean eggs have been found associated with the swimming feet of *Pterygotus*, and plates of *Pteraspis*, at Trimpley, near Kidderminster, where Mr. Roberts discovered the Lower Old Red and its characteristic fossils.*

Another locality for Old Red fish, is round Acton

* Rocks of Worcestershire, p. 100.

Beauchamp, not far from the quarry we have been considering. Here Mr. Humphrey Salwey obtained some of his finest specimens of *C. Lyellii* and *Zenaspis Salweyi*. *Zenaspis* is a kind of *Cephalaspis*, with tubercles on the head plates, and larger than is *C. Lyellii*.

Another locality within easy reach of Malvern is the Knightwick section on the railway from Worcester to Bromyard. The country around is rich in picturesque scenery and historic lore, and full of interest to the botanist and geologist. The Talbot Inn, at Knightsford's Bridge, upon the Teme and beneath the Silurian hill of Ankerdine, is a good halting-place, and opposite is Rosemary Rock, famous for Permian breccias; while within a walk are the Silurian rocks of Abberley, and the Camp of Woodbury.

The section immediately opposite the Knightwick Station is itself a study, with faulted Triassic sandstones, interstratified with beds of angular breccias, which were no doubt derived from the Rosemary rock close by, when the waters of the Triassic lagoons washed against the coast line formed by the Ankerdine Hill, and the Rosemary Permian beach. Beyond the Knightwick Station the Lower New Red Sandstone (Bromesberrow beds) is seen resting unconformably against a mass of upheaved Silurian rocks, which appertain to that elevated area which strikes southwards to the Malverns and northwards to Abberley. There is a dome apparently of Wenlock beds on the right hand of the railway section going west, and on the left are Ludlow rocks, Downton beds, and the Passage rocks, all of great interest. Still farther on the line, and near the next station, the railway was excavated through a cutting which furnished to the researches of Mr. Reece the remains of fishes and

plants, and an *Estheria*, a small crustacean which occurred in grey bands very like the grits at Ledbury which contained *Auchenaspis*. We obtained plates of Old Red Ganoids, *Pteraspis* and *Cephalaspis*, from the rocks in this section.

The name *Cephalaspis*, or buckler head, tells of the plates on the head of this fish, and with the *Pteraspis* may be said to mark the position of the Lower Old Red; and the passage beds below. The species differ according to the horizon of the rocks, and no species known in the passage beds ascend into the Old Red proper above, as far as is yet known. In Scotland as well as in England, *Cephalaspis* appertains to the lower series of strata, where it is more often found entire than in Siluria. The only other locality within easy reach of Malvern, where Old Red fossils were obtained in any abundance is in the railway cutting below Wall Hills; and from the cornstones of the middle and upper part of the hill, which some years ago were worked for building purposes, but now the quarries are closed. From this railway cutting Henry Brooks obtained several good spines of *Onchus*, and a number of scales which for a long time puzzled us. Now I believe them to be the scales of the tail of *Pteraspis*. The cornstones of Wall Hills are remarkably full of veins of carbonate of lime. The Norman font at Bosbury is probably carved out of the Wall Hills cornstone.

The rambler should see Bosbury Church, for, as well as the font, there is Norman work at the south door, with a stoup at the entrance for the sprinkling with holy water. There are also some interesting monuments in the chancel, of the date of the 16th century. John Bridges (1744), of Old Colwall, was also buried at Bosbury. I imagine this worthy

was a descendant of that Thomas de Bruges who was the selected champion of Bishop Cantilupe of Hereford, against Gilbert de Clare, the Red Earl of Gloucester, in their quarrel respecting the chase of Colwall and Eastnor. It appears that John de Breton, Bishop of Hereford before Cantilupe, offered no opposition to the claim laid by the Red Earl to this chase, from whence in former times the bishops had drawn a large supply of venison. Bishop Cantilupe, however, in the first year of his accession (1275), determined to put a stop to the claim raised, and "Thomas de Bruges, pugili episcopi, Herefordensis," was the champion selected to challenge De Clare to mortal combat, if an appeal to judicial combat was allowed by the king. The appeal, however, was settled by the lawyers in favour of the bishop, A.D. 1278, after much dispute. Seven years after the death of Bishop Cantilupe the Red Earl married the Princess Joan d'Acre, daughter of Edward I. (1289), and it was on this occasion that Edward I. granted the entire chase of Malvern to his son-in-law; and then, in all probability, the great fosse, or "The Red Earl's Dyke," was dug along the crest of the Malverns. Even then the dyke went over land claimed by the Bishop of Worcester, which was at last settled by the Red Earl and his princess sending so many bucks and does from their castle at Hanley (Upton-on-Severn) to the Bishop at Kempsey (Swinfield Roll, Camden Soc.) The Bishop's palace was near the church at Bosbury, and it is probable that the early English chancel arch dates from his times. All that remains of the Bishop's palace is an archway of Old Red Sandstone, and a portion of some ruined walls. During the latter portion of his life Bishop Swinfield lived much

at Bosbury, and from the Swinfield Roll we learn that he there kept right good cheer. Here, too, he issued a sentence of excommunication against those who accepted an invitation to a Jewish wedding (August, 1286). At the Crown Inn, in the village of Bosbury, is an interesting old room which is said to have been the "lodge room" of Bishop Swinfield. If it was, it seems afterwards to have been taken in to the Manor House of the Harfords, in the 16th century, for their armorial bearings are over the fireplace. On one of the bosses on the roof are the armorial bearings of Bishop Skipp, one of the compilers of the Book of Common Prayer, and the first Protestant Bishop of Hereford. His successors afterwards resided at Ledbury (The Upper Hall), and became Herefordshire gentlemen.

With regard to Wall Hills, with its hard cornstones which have protected it from denudation, it rises, as Camden wrote in the days of Queen Elizabeth, "as the fortification on the neighbouring hill" of Ledbury, and which "was the seat of war first between the Romans and Britons, and then between the Britons and Saxons." Mr. Gough, who was Camden's annotator (1789), derives the name Wall Hills from the hill with the vallum, and he records that "Mr. Skip had certain lands called Wall Hills, where about 30 or 40 acres of land are encompassed with a high mound which has three entrances, and on the south side was formerly a vineyard. In ploughing here have been found spear and arrow heads, brass coins, horse shoes of an antique form, and the bones of men." Roman tiles and pottery have been found by Mr. Riley north of Wall Hills, at Putley Court.

. A visit to the hills above Canon Frome will afford

the geologist the opportunity of examining some quarries, but I fear the remains of fish are rare. We become acquainted, however, with the physical position of the cornstone hills, which are studded over Herefordshire. Having done this it would be well to leave the Malvern district, and make Hereford a place of sojourn, from which to visit a few fossiliferous localities, which may interest the explorer as well as supply his cabinet with fish remains. It is but a short walk from Hereford to Sutton Walls, which Giraldus Cambrensis, who was tutor to King John, calls King's Sutton; and of which Leland notices the "notable ruines of some ancyent and great building, sumtyme the mansion of King Offa at such time as Kentchester stood, or els Hereford was a begynning." Some years ago the roads were mended with stone very rich in fragments of *Cephalaspis*, from a quarry either at Sutton or Marden, if such is still worked. The Rev. Mr. Barker found a nearly perfect *C. Lyellii* in this neighbourhood. Hereford is the head quarters of the Woolhope Club, so called in honour of Sir R. Murchison, that district being typical of the rocks among which he worked so hard, and which is surrounded by Old Red Sandstone of the development of which, and around Herefordshire he said, "there is no other such tract in the world." The Woolhope Club has since its foundation made its mark among natural history societies by its "Transactions," which owe much of their value to the care of Dr. Bull. Indeed it is only fair to say that this gentleman has been the chief promoter of the fungus meetings, which have justly become celebrated; and of the publication of the *Pomona of Herefordshire*, which must be of great

value to the horticulturist. Another of its members. Mr. Rankin, has founded a free library and a museum, which will, we doubt not, before long, exhibit good collections illustrative of the county of the Old Red. One of the most fossiliferous localities for the collector of fossils, provided the quarries are still worked, an important consideration, is in the neighbourhood of Leominster, and we cannot give better directions than to proceed by rail from Hereford to Leominster. The rail passes through great pastures of alluvia, once lakes, and fringed by old river beds, which furnished the remains of rhinoceros, mammoth, and fossil bisons, to the researches of our friend, Mr. Curley, C.E., ever on the look-out for any fossil relic which will elucidate the geology of "ould Herefort." Arrived at Leominster, the Rambler who combines the love of archæology with that of geology will first visit the church, which is remarkable for its remains of Norman architecture. Old Leland visited it, in the days of Henry VIII., and says: "Yt is a grate likelihood that yt is the church that was afore the conquest.*"

The geologist should take the line of quarries from Kimbolton church by Leyster Sprowle, returning by Puddlestone and Birch. I have several times seen the glad faces of young geologists when visiting the quarries at Leyster Sprowle, and the bony plates of the old ganoid fishes were seen on the stony slabs glistening with purple in the sun. Plates of various forms of cephalaspidean fishes have been found here, and now and then a head or tail, not of "lusty trout" and "here and there a grayling," but of those old world forms which have left so few living representatives in the waters of present lakes, rivers, or seas. The

* Records of the Rocks," p. 223.

cephalaspidean fishes at the present time number some 15 genera and upwards of 50 species, with very long and hard names such as *Hemicyclaspis*, *Holaspis*, *Cyathaspis*, *Scaphaspis*, *Didymaspis*, and *Eukeraspis*; and the only possible way of determining and arranging specimens is to consult Professor Lankester's monograph on the "Fishes of the Old Red Sandstone."* The most numerous forms found at Leyster's Sprowle, or on the horizon of these beds near Leominster and Pembridge, are the *Scaphaspis* (*Pteraspis*) *Lloydii* and *Lewisii*. Some of the Old Red fishes have been named after their discoverers by those who like Murchison, Salter, Lankester, and Etheridge have had the honour, the honesty, and the courtesy to acknowledge the work of amateurs.

The large quarry at Puddleston afforded examples of ripple marks, which shows that the strata were deposited in shallow waters and on what must have been a shore. Years ago we sent specimens to Sir William Jardine for his "ichnology room." A very fine slab with marks of some animal having crossed the ripple marks was obtained here by the Rev. T. T. Lewis. This slab is now in the Worcester Museum.

Another locality for quarries in the Cornstones is Weobly, a quaint old town. We pass by the White Cross which was erected, according to Dr. Duncombe, on the site where the weekly markets were held during the awful visitation of the "black death" in the reign of Edward III. Credenhill is a fine hill of cornstone, and on the summit are the remains of a large camp supposed to be Roman. It was on this hill, not on Dinmore hill, in all probability, that the signal was hoisted when Prince

* Mon. Pal. Soc., vol. 21.

Edward escaped from Widemarsh, at Hereford, and galloped to join Mortimer, who conducted him safely to Wigmore.* Dinmore hill, which tradition assigned as the signal hill, is not visible from Widemarsh.

Another route recommended is to take the line from Hereford to Abergavenny, stopping at Pontrilas Station for the cornstone districts of Ewyas Harold, Kentchurch, Grosmont, Pontrilas, and Rowlestone, for accounts of which I must refer the reader to my work, "The Records of the Rocks. I would, however, direct attention to a quarry above Kentchurch Court, which my brother, J. F. Symonds, has lately discovered to be very fossiliferous, and which has furnished us with many specimens for the cabinets of our friends, and amongst others Professor Hughes, for the Sedgwick Museum at Cambridge. The road to this quarry is up Kentchurch Hill, which leads to Ross, and is due east from the Pontrilas Station. From the hill itself there are fine views of the surrounding country. Westward are the Upper Old Red rocks of the Black Mountains, rising like Scotch hills in the Lowlands, with their heather and grouse, but all rounded, and with no ragged precipices or towering peaks. Below these and toward Abbey Dore and Whitchurch are wooded hills of cornstone, which are all the mausoleums of fossil fish, whose relics are found wherever a quarry is opened. The heaps of stone by the side of the hill contain broken specimens, often in considerable numbers. Arriving at a cottage on the hill top, the quarry is situated among fields to the north of the gamekeeper's house. It is but a small quarry, but is very fossiliferous. The plates of *Scaphaspis* (*Pteraspis*)

* "Historicus," in *Hereford Times*, January, 1879.

Lloydii are numerous and very fine, with remains of *Pteraspis* and *Cephalaspis*, the species of which I do not venture to name. The rarest perhaps is *Gallus tauri*, which is founded on one hexagonal pimple, with short delicate pustules. This pimple may have belonged to the frontal, central, or discal regions, or possibly to the cephalic disk. Being merely a pustule, we can only form an idea of the general shape of the heterocerebral tail, or the position of the notochord. The symphysis of the jaws are gone, and also the osseous lacunæ.

With *Cephalaspis* and *Pteraspis* we also find the ornamented structure of that large fish, *Zenaspis* (Lankester), found by Dr. Elmes Steele in the neighbourhood of Abergavenny; and the spines of some fish hitherto undescribed. Walking from the quarry, eastwards, to Kentchurch Court and the Munnow, the geologist will pass over a series of cornstones and sandstones, which make up the hill. The thick bedded sandstones are interstratified with cornstones, and the sandy beds are rarely fossiliferous. At Kentchurch Court there is a rude painting of "Jack of Kent," which Colonel Scudamore believed to be the portrait of the celebrated Owen Glendower. One of Owen Glendower's daughters was married to a Scudamore, and the renowned Welsh chieftain is said to have died at Kentchurch, after living there for several years as "Jack of Kent," who built a bridge over the Munnow in a single night. If the geologist ascends Kentchurch Park, or the bold Graig, opposite, across the Munnow, he will see how the brownstones, which overlie the cornstone group of strata, and which we suppose to be the equivalents of the Middle Old Red of Scotland, begin to set in, but which we must examine among the hills of the

Black Mountains and the Brecon Vans, in order to see their full development. The Cornstones around Abergavenny have supplied some beautiful specimens to the cabinets of Dr. Elmes Steele and Dr. M'Cullough, and the fish spines from this district are, for the Lower Old Red, very fine and well preserved.

THE MIDDLE AND UPPER OLD RED.

If the student will consult his Lyell's "Elements of Geology" he will find that certain rocks which overlie the Lower Old Red of Scotland are classed as "*Middle Old Red Sandstone*." These rocks contain a great many fish, to which attention was first directed by Hugh Miller, and many of which are described in his celebrated work. Among these are *Osteolepis*, *Coccosteus*, *Dipterus*, *Diplopterus*, and *Asterolepis*, with several other forms of ganoid fishes, none of which as yet have been discovered in Siluria. I hope that geologists will yet discover remains of these fishes in that great group of rocks which overlies the cornstones and underlies the Old Red Conglomerate and the yellow sandstones which form the uppermost beds of the Old Red Sandstone. These are the "*Brownstones*," a mass of thick-bedded red and grey sandstones, which may be seen largely developed in the mountains of Breconshire and Monmouthshire.* No fossils have, however, as yet been found in the Brownstone strata, which nevertheless occupy a middle group between the Lower Old Reds, with their *Cephalaspis*, *Pteraspis*, and *Pterygotus*, and the uppermost Old Red on the Daren, near Crickhowell, and on the Clee Hills above

* Records of the Rocks," p. 243.

Ludlow, at both of which places an Upper Old Red fish of Scotland (*Holoptychius*) has been found.

The lover of physical geology should visit the Daren and Pencerrig Calch, the Gadir, and the Vans of Brecon if he would comprehend the depths of the Old Red lakes, if lakes they were, and the mass of sediment they once contained where now those mountains rise. There must have been highlands, too, and the wash of many streams to have furnished sediments of such a thickness. Once the bottom of a lake, now bold hill summits,

"Whose lonely columns stand sublime,
Flinging their shadows from on high,
Like dials which the wizard Time
Has raised to count his ages by."

Such are the heights of Gadir, Pencerrig Calch, and Brecon Vans.

The Passage Rocks teach us that Silurian times and Silurian forms of living animals were waning and passing away! New fish appear in the lowest Old Red; and the great lakes which existed in Devonian times, or between the Silurian and Carboniferous epochs, were gradually silted up. But the depth of the lake where now are the Black Mountains and Brecon Vans must have been nearly 8,000 feet. The great American lake, Lake Superior, is not so deep as are the strata of the Old Red from the summit of the Vans down to the Ledbury Passage Beds. The "Brownstones," then, may well represent the Middle Old Red of Scotland. But how shall we describe the physical changes which must have taken place in land and water, of hills elevated or land depressed, between the eons which passed away between the times when the trilobite was buried in the marine silts on the site of

Ludlow Castle ; and the corals of a Carboniferous sea grew over the Old Red of the Brecon Hills ?

I might give many localities for the examination of the Brownstones, but they are a long way from the Malverns, as owing to faulting and thinning out these beds are not well seen in the Forest of Dean. We will content ourselves with one beautiful resting-place for the pedestrian, from whence to see the position of these rocks, viz., Llanthony Abbey. Pandy Station is about five miles from Abergavenny, and let this be the starting point. It is within a mile of the Black Mountains, where they cross eastward from the district above Hay. We pass by an old manor house and ascend the hill, at the base of which the strata crop out. A walk along the hill crest shows deep valleys on either side, valleys excavated in the Lower Old Red. Very different is the scene on the northern, compared with that on the southern aspect. On the right the woodlands and cornfields of Herefordshire spread far and wide and stretch away to the base of the distant Clees, while the eye rests on distant villages and towns. All the scenery on this side is covered with the industry and the haunts of men, while on the other is a bit of wild Wales, with heather-covered hills, distant sheep cropping the short turf, and mountain streams. On the one side are the old church and ruins of Longtown Castle ; on the other the grey decaying walls of Llanthony Abbey.* A footpath down the western slope of the hill leads to the abbey, close to which is a little inn, built in a portion still habitable. There are spiral stone stairs, and haunted rooms to sleep in, with fresh trout from the Hondu, hard by. This is the place I recommend

* "See Records of the Rocks," p. 236.

for headquarters to the geologist who would see the Middle Old Red and ascend the Gadir before he examines the Daren and Pen Cerrig Calch, or the fossiliferous upper rocks of the Titterstone Clee.

If we cannot see the Middle Old Red of Siluria satisfactorily, nearer than the Black Mountains, from Malvern, we can more easily visit sections of the Upper, or transition beds, in the neighbourhood of Dean Forest. As we ascend in the series of the rocks in Scotland we find different forms of fish appear on different horizons. In the words of Hugh Miller: "The curtain rises and the scene is new. The myriads of the lower formation have disappeared, and we are surrounded, on an upper platform, by the existences of a later creation." He tells us, too, of the "formation of the *Holoptychius* and the *Pterichthys*, of Dura Den." In the uppermost Old Red of Scotland the *Holoptychius* is the characteristic fish, but there are several others, such as *Pamphractus* and *Glyptopomus*, perfect specimens of which may be seen at the British Museum, or the School of Mines in Jermyn Street; and in Siluria, *Holoptychius* may be said to be characteristic of the uppermost Old Red, for in no lower beds have either this fish, or the *Pterichthys*, been found through all the vast thickness of the strata from the base to the summit.

Mitchell Dean Road is a station not far from Ross, on the Gloucester and Hereford line, and Mitchell Dean itself is a good locale from whence to examine the Old Red Conglomerate and yellow (Dura Den) sandstones, which pass upwards into the limestone shales, and the Carboniferous limestone of Dean Forest. Mitchell Dean may be best reached from Gloucester or Hereford by railway from Malvern, or driving, by Newent.

The best section is in the road cutting near Drybrook, and by walking up the Ross road the series of strata may be traced from the Old Red conglomerate through the Dura Den series to the transition beds of the Carboniferous series.* The limestone shales were considered by Prof. Harkness, and all Irish geologists who have seen this section, to occupy the exact position of the "carboniferous slates" of Ireland, which are there 5,000 feet thick and lie between the Irish Dura Den sandstones and the Mountain limestone. The yellow beds in the Drybrook section did not yield any fish, but there were many plant remains although in a triturerated condition. In Ireland the Dura Den beds have yielded land plants in abundance such as *Knorria* and *Stigmaria*, with a few fish remains, and a freshwater mussel (*Anodon Jukesii*). Across the Severn, in these yellow sandstones, Earl Ducie discovered *Knorria*, near Tortworth Court, and it also occurs in the equivalent rocks of Farlow on the slopes of the Clees. Another section, in these rocks at Dean Forest, is at the railway cutting near Sudely, but this would be best reached from Newnham. The Old Red conglomerate is well shown on the Wye between Ross and Monmouth below the celebrated rock and entrance to the forest known as "Symonds' Yat," once the pass, or gate, to the residence of an ancestor of the writer of these notes. Ascending to Symonds' Yat from the ferry on the Wye, the yellow beds are marked along the slopes; but they may be traced above the Old Red conglomerate on the opposite hill of the Great Doward, when ascending from Whitchurch on the road to the celebrated bone caves of Arthur's Cave and those of Mr. Bannerman.

* See section "Stones of the Valley," p. 10.

The yellow sandstone is so little quarried or exposed in the Forest of Dean, or along the Wye, that it is almost impossible to hope to obtain specimens, and I must ask my readers to examine the summit of the Daren above Crickhowel, and the grey and yellowish beds, for relics of *Holoptychius*. Here Sir Roderick Murchison found the impression of one of the scales of this fish; and other specimens have since been obtained there with impressions of the stems of plants, probably of *Knorria*.

Crickhowell and Abergavenny, then, are situated on the Lower Cornstones (the equivalents of those at Wall Hills near Ledbury), above which rise the hill masses of the Scyrrid and the Sugar Loaf, the Blorenges, the Daren, and Pencerrig Calch. The Carboniferous rocks are denuded from the Scyrrid and the Sugar Loaf, but they are left on the Blorenges and on the outlier of Pencerrig Calch. This isolated mass of carboniferous rocks rests on the Upper Old Red of the Black Mountains, and is separated from the Blorenges and the South Welsh Coalfield by the great valley of the Usk, which is a line of fault. It is not easy to believe that the Carboniferous rocks of Dean Forest and the South Welsh Coalfield were once continuous with those far away to the northwards on the Clees; or that it is denudation which has stripped them off from the plains of Herefordshire and Shropshire; or that denudation has exposed the Lower Old Red beds and the upheaved Silurians. Yet the Geologist who will examine the country instead of depending only upon maps and books, will, I believe, soon be convinced that such is the fact.

There was a theory started that the Carboniferous limestone of the Clees might be isolated coral reefs

round an Old Red upheaval in a mountain limestone sea. But these transition yellow beds, with their Holoptychian scales on the Daren, and their similar position in the Forest of Dean, corresponding as they do with those at Farlow by the Titterstone Clee, upset this theory *in toto*. Nor is it the Dura Den beds which alone tell of the continuity of the rocks. *The Old Red Conglomerate* is on the Clees, as well as the yellow sandstones, so we have the same rock supporting the coal of the Clees as on the Welsh mountains and the Forest of Dean, from the Old Red to the Millstone grit inclusive.

The Clees Hills are so well seen from the Malverns, and present such remarkable geological phenomena that a few words might be useful to the stranger or local geologist who has not visited them but hopes to do so.

The geology of the Clees corresponds in some measure with that of a country where volcanic action has been active in later times, such as Auvergne, where rocks have been preserved from denudation by the overflow of basalt or lava. But the basalt of Auvergne overlies Tertiary rocks, whereas that of the Clees was poured out through and over the coal measures.* The relations of the Middle Old Red to the Lower are not nearly so well seen on the Clees as across Herefordshire in the hills of the Black Mountains, as there is much faulting and dislocation of these rocks. Brownstones are, however, quarried above Bitterly Court, on the western side of the Titterstone Clee, and at Abdon and Ditton below the Brown Clee. Another difference at the Clees strikes us at once, viz., the dislocation and downthrow of

* "Geology of Church Stretton and Ludlow." Trans. Shropshire Archaeological Society.

the Mountain limestone and the Dura Den sandstones *before the deposition of the Millstone grit*, showing that earthquake movements and volcanic action were here active which were not so at the Bloreng and the South Wales coalfield, and that thus considerable faulting had taken place *before the coal* was deposited.

Cleobury Mortimer should be the headquarters of the geologist when collecting fossils of the Dura Den or Transition yellow beds. It is a quaint old town, and Mr. Weaver Jones possesses a collection of the rarest fossils in all Siluria—fossils from the uppermost Old Red Sandstone of Farlow. Here is the *Pterichthys* which Hugh Miller first found in Scotland, and tells, in his "Old Red Sandstone," of the feelings with which he contemplated his first specimens; how the specimens were sent to Murchison and Agassiz; how Sir Roderick thought they would "form the connecting link between crustaceans and fishes," and Agassiz pronounced the *Pterichthys* to be a fish. The first *Pterichthys* was found at the Clees (Farlow) by Mr. Baxter, a well-known Worcester botanist, the friend of all Worcestershire naturalists, and who now lies in Worcester Cathedral. I sent this specimen to Sir P. Egerton, who pronounced it to be allied to the *Pterichthys hydrophilus* of Dura Den,* an important point when we consider the position of the Clee Hill and Scotch rocks.

Besides the *Pterichthys* many scales of *Holoptychius* have been found, and we have seen them from the transition beds at Farlow, miles away, on the distant Daren above Crickhowell. Hugh Miller directs attention to the size, large scales, and plates of *Holoptychius*, as compared with the

* "Records of the Rocks," p. 250.

smaller fishes of the Lower Old Red, and certainly the visitor to the British Museum who compares the huge teeth and plated armour of some of the Upper Old Red fish with the stickleback-like spines of the *Onchus* of the Ludlow bone bed, or the little plates of the *Scaphaspis*, must acknowledge that the first fishes, as we know them, were pigmies which were in after times to be succeeded by giants.

Walking upwards from the downthrow of the Old Red and mountain limestone at Farlow, to the eastern summit of the Titterstone Clee, we pass over the entire series of rocks which support the South Wales coalfield. They are not nearly so thick, but there they are! Many remains of mountain limestone fishes such as *Helodas*, *Cochliodus*, *Cladodus*, &c., have been collected by Mr. Weaver Jones at Farlow, and all these forms have been found in the mountain limestone of Dean Forest and South Wales.

It has been supposed, that the geology of the Clee Hill coal strata belongs to that of the coalfields of Wyre, and Coalbrookdale, but we believe that these coalfields were deposited under different conditions. There are no yellow sandstones, no mountain limestone, no millstone grit at Wyre Forest or in Coalbrookdale! All these stratified masses enter into the geology of the Clees. The history of the preservation of the Clee Hill coal measures from denudation by the erupted basalt (*Dhūstone*), and of the distant outlier of Pen Cerrig Calch, where it rises beyond the vales of Herefordshire amongst the Black Mountains; the fish of Oreton and Farlow, corresponding with those of the same horizon on the Daren, the Bloreng, and Dean Forest, are all lessons the lover of the lore of physical geology will rejoice to behold, among the hills of the Clees in

Shropshire, and far beyond to the westward by the waters of the Wye and Usk.

William Longland who wrote the "Complaint of Piers the Ploughman," was born at Cleobury Mortimer. His dreams are supposed to have passed before him in visions on the Malverns, and his allegory is remarkable for the force of its delineations. It is not improbable that the gross conduct of such as "William of Ledbury," who was prior of Great Malvern, in days not long before his own, called forth his bitter denunciation of pompous ecclesiastics. It was John of Gaunt, "time honoured Lancaster," who took up the cause of Wycliffe and saved him from ecclesiastical persecution; while the "Complaint of Piers the Ploughman" describes John of Gaunt as the cat who saved the mice, or common people, from utter destruction by the rats or nobles. William Longland wrote in London, in poverty and sorrow, but it was to the Malverns, associated no doubt with the days of his childhood, that his soul yearned, when stricken at the sin and sorrow of the poor man's lot in the days of Edward III. and Richard II. On the Malverns the visions came and went as he "was very forwardered and went me to rest under a broad bank by a burnside, and as I lay and looked in the water I slumbered in a sleeping it sweyved so merry." A little longer and there were the fires of religious persecution. But this is only one of the many episodes the great drama of history summons to our view, when we stand upon the summit of the Worcestershire Beacon, or the North Hill, and look upon scenes which lie before us as we gaze first on one side then the other across the vales.

A few brief allusions to some of the most remark-

able localities which are seen from the North Malverns, and are connected with historic associations, may be interesting to the naturalist, who combines the love of archæology and history with his own pursuits.

The Worcester Beacon itself was in former ages a great Fire Beacon, which flashed forth its signals to sixteen surrounding counties. It was, too, the burial place selected for some chieftain of the ancient Gael or Cymri, whose rude urn and calcined bones were found by Mr. Edwin Lees on the very summit.* This burial site is nearly opposite to that of Belas Knap across the vale where, near Winchcomb and Sudeley, are still to be seen the remains of a large stone burial place, of a race of men who lived in prehistoric times, used flint implements, and were ignorant of metals.†

Through a field glass we may easily see the cathedral, churches, and each place of note around the "faithful city" of Worcester. Roman relics are constantly being found at Worcester, but of its Roman history nothing is known. It is probable that it was the Wyre-cester or camp in the great forest of Wye, which extended to the westward in the times when the Romans obtained salt from the wiches or salt springs at Droitwich. We know, however, that it was a Mercian see in the days of King Offa and of Wulphere, who rebuilt Gloucester (660). From Worcester Bishop Ecguine went forth on missions to Pagan miners who lived in the wild woods about Alcester, and dreamed dreams and saw visions which led to the foundation of an abbey at Evesham.

* See Mrs. Dent's, "Annals of Winchcomb and Sudeley."

† "The Forest and Chase of Malvern" (Lees), p. 65. Trans. *Malvern Field Club*.

Later on, Dunstan, the priest and statesman, sorcerer, musician, ritualist of the early church, and Abbot of Glastonbury, was Bishop of Worcester (950 A.D.); and in Saxon times Worcester became an important stronghold. Florence of Worcester is an old chronicler on the Danish kings and their doings, and the Danes we know carried fire, pillage, and the sword, all up the Severn in the days of Sweyn; while later on, when Hardicanute was king, we find him burning the cathedral while some of the inhabitants took refuge upon the island of Bevere.*

The crypt of the cathedral some antiquaries believe to be as old as the days of Bishop Wulstan, who rebuilt it. Wulstan lived from the days of King Canute to those of the Red King, the one Bishop of English blood who survived the changes of the Conquest.

Worcester met with a hard fate in the times of King Stephen and the Empress Maud, being twice sacked and burnt by the contending forces.

Henry II. was crowned for the third time in Worcester Cathedral, and afterwards held a court at Kempsey. This politic and crafty monarch, who was foiled by a monk and died hunted to the death by his own sons, rode through the streets of Worcester and passed down the Severn in his barge (A.D. 1157). Rosamond Clifford was a Herefordshire lady. In Worcester Cathedral is the grave of his son. But not all the superstition with which King John was filled to overflowing, nor all his supposed faith in the aid of the good St. Wulstan, could change that awful verdict of his contemporaries, "Foul as it

* "Historical Associations around the Malvern Hills," in reports of Severn Valley Naturalists' Field Club.

is, hell itself is defiled by the fouler presence of John."

The cathedral was again destroyed by fire in 1202, and was rebuilt and dedicated in 1218 in the presence of Henry III. Henry, weak as water, was nevertheless surrounded by a class of intellectual Englishmen. There were Bishop Grostete, and Matthew Paris, Roger Bacon, and Roger of Hereford living in his days. Architecture, too, was becoming splendid, witness the Abbey at Westminster; but we are reminded of episodes in his reign marked by civil wars, bloodshed, and slaughter, the sites of which are visible from the Worcestershire Beacon.

On the westward, across the plains of Herefordshire, we see the dark tower of Hereford Cathedral, which rises above the Castle Green, the former site of the strong castle where Simon de Montfort imprisoned Henry III. and his son, Prince Edward. Not far beyond is Widemarsh, from whence the Prince galloped for life and liberty to meet Mortimer of Wigmore, and, as already mentioned, we see the hill where Mortimer's signal standard flew, and the country over which the gallant Edward escaped. But it was at Worcester that the Prince raised his standard after his escape from Hereford, previous to the battle of Evesham. Then turning to the eastward we can see the spot, or very close to it, where Simon de Montfort fell; and that battlefield where "180 knights and 10,000 common men" were taken and slain. The "Red Earl," who afterward married Prince Edward's daughter, and dug the Malvern boundary dyke, fought for Simon de Montfort at the battle of Lewes, but for Henry III. and Prince Edward at the battle of Evesham (1265).

A glance at the line of the Severn where it runs by

the Rhydd Ford below the wooded hill of Dripshill shows us the place where de Montfort crossed with his army; and beyond is Kempsey, where he passed the night with the Bishop of Worcester. His mutilated body was laid before the high altar of Evesham Abbey, and for ages after the prayers of a people who loved his memory ascended from his grave. His head was sent to Wigmore Castle, to the wife of Mortimer, and somewhere there perished in decay the noble countenance of "the good Earl Simon."

When Prince Edward became king, architecture of Early English design reached its highest beauty. We see its "stately lines" at Salisbury, York, Westminster, and our own cathedral at Worcester. This was an era of church architecture, and the Knightly King and King of Knights was several times at Worcester. He kept Christmas at Worcester in 1291 and rowed down the Severn to Kempsey with his Queen. He was present at Worcester Cathedral when Llewellyn, the last Welsh Prince of Wales, married Elinor de Montfort, daughter of his former foe. It was a Mortimer of Wigmore who lay in ambush for Llewellyn, and murdered him in the Cwm which bears his name, by the ancient castle of Builth, and his old home of Abereddw.

The unhappy reign of Edward II. has its episode within sight of the Worcestershire Beacon. After he had been seized in the woods of Llantressan, in Glamorganshire, he was sent as a prisoner "by way of Ledbury to Kenilworth Castle." We must suppose, therefore, that he was taken through Worcester. Afterwards it was Mortimer of Wigmore who, with the "She Wolf of France," compassed his murder at Berkeley Castle. In 1329 Mortimer was created

Earl of March or Lord of the Welsh Marches. That same year Queen Isabella implored her "sweet son" to spare her "gentle Mortimer," but the "gentle one" was soon hanging as high as Haman.

North of the Worcestershire Beacon we see on a clear day the country "all round the Wrekin," that hill itself rising boldly into view. In the same direction, but comparatively near, are Woodbury Camp and Abberley Hills, both of historic interest.

Henry IV. and his reign stand out before us marked by the curse of persecution for religion's sake; for priests such as Archbishop Arundel; for martyrs such as Thorpe and Sautre; for tortures by fires and hanging in chains; for the Welsh struggle under Owen Glendower, and the stamping out of liberty of thought and conscience. As Duke of Hereford, Henry of Bolingbroke was much in Siluria and often at Worcester. During his reign Owen Glendower marched his army to Worcester, took it, and afterwards fell back upon Woodbury Camp, which he occupied for some time, making raids on the country round. Henry IV. occupied Abberley Hill with his troops, but it was his son, the Prince of Wales, Henry of Agincourt, who was destined in after years to win victory from the Chief of Glendowerdy.

Not far to the north-westward of the Wrekin is the field of the battle of Shrewsbury, where Douglas threw

"A brave defiance in King Henry's teeth,"

and Percy, "nobly fighting, fell;" where Falstaff had but "three of his hundred-and-fifty left," and "fought a long hour by Shrewsbury clock."

If Henry V. was a great General he was a stern persecutor, and he allowed one of his old friends, Sir John Oldcastle, a Herefordshire man, and con-

nected with Worcestershire, to be hung alive in chains, and a fire slowly kindled beneath his feet.

Salwarp, near Droitwich, is easily seen from the Worcestershire Beacon; but I suppose that few remember that Richard Beauchamp, Earl of Warwick, the "Father of Courtesie," the guardian of Henry VI., and once Regent of France, was born at Salwarp, and was a Worcestershire man. It was of him John Rous, the antiquary, wrote the fame. He took in open battle the standard of Owen Glendower; and, later on, he fought at Shrewsbury. He was at Agincourt, and other victories over the French, with Henry V., and he died at the Castle of Rouen in 1349. His magnificent monumental tomb is in the Beauchamp Chapel at Warwick; while his wife Isabel Despencer lies at Tewkesbury by the side of her first husband, Richard Beauchamp Earl of Worcester, to whose memory she erected the beautiful Beauchamp Chapel, before she married the Earl of Warwick, although this chapel is most erroneously called "the Warwick chapel"!

Prince Arthur, son of Henry VII., who died at Ludlow Castle, was buried in Worcester Cathedral, in the beautiful chapel which bears his name.

The quarrel of Henry VIII. with Rome, made Hugh Latimer Bishop of Worcester, and from Worcester Cathedral he soon turned out the figure of the Virgin. Alas, too, the historian may not forget that on the 22nd of May (1539), "a monk was hanged up by the armpits, and underneath him a fire was made, wherewith he was slowly burned." Also "that there was a pulpit erected near the stake from which Hugh Latimer, Bishop of Worcester, preached a sermon."* Nor, on the other hand, should we forget

* Hall: Stow; Godwin.

that he pleaded earnestly with the King to save the Priory of Great Malvern, but he pleaded in vain ! It is somewhat singular, too, that Bishop Bonner, to whom Queen Mary wrote "rattling letters," urging the burning of Latimer and Bishop Ridley of London, was himself a Worcestershire man, the son of a cobbler at Hanley Castle, in the vale opposite the Worcestershire Beacon. He sometimes, when Bishop of London, resided at Pull Court, now the noble seat of the Dowdeswells.

Stately manor mansions had arisen in many parts of England by the time Queen Elizabeth succeeded to England's throne. There was Hendlip and Westwood, near Worcester, and we find the Queen visiting Worcester, and I believe Westwood. At all events she hunted in Colwall Park, and left at Worcester, as a present to the Corporation, a pair of black gloves of a very large size, and embroidered with a golden crown.

To the north-east of Worcester we see the Lickey Hills, where still grow the heather and the bilberry, and waters rise, which flow on one side to the German Ocean and on the other to the Irish Sea. Northward of the Lickey rise the Clent Hills, and on the eastern slope is a curious old church, built of dark red Permian sandstone, which marks the site of the murder of Kenelm, at the instigation of his sister, Kenrida. On their west is Hagley, "The British Tempe," of Thomson's "Seasons;" and which is associated in the poems of Pope and Shenstone with the intellectual Lord Lyttelton. The Leasowes, at Halesowen, was the home of Shenstone, and the fine old church owes its rescue from decay to the reverend and venerable Archdeacon who lives beneath the shade of its tower. Then to the north of Worcester,

but near comparatively, we look upon the site, but alas no longer on the old manor house of Hendlip, where "Mayster Thomas Abbingdon and "Maister Humphrey Lyttelton" conspired, at the time of the Gunpowder Plot. The old manor house was full of "secret corners and conveyances," "all of them having books, massing stuff, and Popish trumpery;" and "with these were hidden the Jesuits, Owen and Chambers, Hall and Garnet, among marmalade and other sweetmeats," and who were fed "by a quill or reed, through a little hole in a chimney, with caudle, broths, and warm drinks." Here, too, was the "skeleton room" in the chapel, and strange walks and gardens. Now we only see the place where it stood occupied by a mass of bricks.

The Civil Wars brought sad times upon Worcester and the neighbourhood. In 1642 there was a good deal of bloodshed between the troops of the Earl of Essex, and those led by Prince Rupert. Essex was at Worcester when King Charles I. raised his standard at Nottingham, and the armies met on the field at Edgehill, which on a clear day may be seen from the Worcestershire Beacon, looking across the field of the battle of Evesham. Worcester withstood two sieges, but the battle of Worcester was fought in 1651, nearly two years after the unfortunate Charles I. was laid in the tomb at Windsor. Engagements were fought at both Upton-on-Severn, and Powick. We see the white spire of the new church of Upton, which is built on Buryfield, where the dead were buried, but they fell principally round the site of the old church which was knocked about by the cannon of the Parliamentarians, while the bridge over the Severn was half destroyed. There was a *severe struggle*, too, about the bridge at Powick, and

Charles II. is said to have been present in person for some time. The "crowning mercy," however, as Cromwell termed it, was after the charge of the Ironsides, from Perry Wood, and the stern fight round the Commandery within the walls of Worcester. We see Perry Wood Hill rising behind the Railway Station; and the northern road towards Hartlebury was that of the flight to Boscobel. Just below Malvern, facing the North Hill, is the old house of Pickersleigh, which tradition says, was the refuge of more than one fugitive from the battle of Worcester.

Hanley Castle, which is near Upton-on-Severn, was a keep, tradition says, as early as the days of Brittric or Beortric, who married King Offa's daughter, and who was buried at Tewkesbury. Later on, as we have seen, Hanley was sometimes the residence of the Red Earl and his royal princess, Joan d'Acre. It belonged still later to Warwick the King Maker. Now not a stone is left of the once venerable pile; nothing but the moat and its great trenches. It was quarried to build farms and cottages, and the Goths who quarried it have left not a wreck behind. A modern building of brick and stones stands upon the site of fortifications which were strongholds of those who ruled the destinies of England and of English Kings. Tewkesbury, Deerhurst, and Gloucester—all on the Severn, have been alluded to, and there are many other historical localities round the Malverns, especially on the Hereford side, which our limited space forbids us to allude to.

We commenced by an account, however imperfect, of the Old Stones to be seen and studied within reach of our grand old hills! We conclude with records of the doings of Man on sites which may all be dis-

tinguished from their summits. It is well to associate, in our travels and explorations, the history of the stones and their fossils, the stars in the heavens, and the flowers of the field. For all living things, from the coral animal up to Man, are of the Creator's work; and God Almighty's works are ever worth examining, whatever fools may say to the contrary. Sought for themselves, their beauty and wonders, and outside of the element of professional jars and jealousies which are human, the love of Natural History never leaves a sting behind. The cultivation of such knowledge has less of human prejudice around it than aught else in this world besides.

With respect to history,

"Pursue the search and you will find
Good sense and knowledge of mankind
To be at least expedient."

For, at all events, it adds much to the pleasure of a rambling geologist, when he finds himself among ancient ruins and old churches, to be enabled from his knowledge of history to recall scenes of the past, and to invest the mouldering stones with an interest they can never possess to one who is ignorant of the events which happened in the very neighbourhood in which he lives. There is nothing which strikes the educated American so much as the Englishman's want of knowledge of the history of his native land; and nothing strikes an Englishman more than the knowledge the American possesses respecting our English kings, our wars, our heroes, and

"The natural bravery of our isle; which stands
As Neptune's Park, ribbed and paled in
With rocks unscaleable and roaring waters."

CHAPTER
ON THE
DRIFTS OF THE SEVERN STRAITS.

OLD STONES.

DRIFTS OF THE SEVERN STRAITS.

AN account of the Old Stones in the Malvern district would be imperfect without some allusion to the *Drifts* which afford the Geologist so much information respecting the changes which have occurred during the later Geological periods.

The finding the remains of rich Forest lands, covered in Cretaceous and Miocene times with forest trees and flowering plants within $8\frac{1}{2}$ degrees of the North Pole, indicates the remarkable change in the climate of our northern hemisphere during the bygone ages of Geology. Arctic expeditions now coal with the fossil fuel furnished by trees which grew where now are eternal snow and ice. As surely as there was a time comparatively recent in the æons of Geology when forests grew in the North Polar regions, so is it certain that an intensely cold climate set in at the close of the Tertiary ages, and that during later Pliocene times the cold became so rigorous that the land of the northern hemisphere was glaciated or buried under ice sheets of great thickness, while every *sea strait*, where in summer the waters were for

awhile open, was traversed by masses of floating ice often bearing rock masses and erratic stones.

The causes of the Glacial epoch have occasioned much controversy, with which we cannot deal here,* but there is no question among Geologists respecting the glaciation of the northern hemisphere since Pliocene times, or that the First period of the Glacial epoch came gradually on until the climate was so rigorous that Scandinavia, Finland, large tracts of Russia west of the Ural Mountains, Denmark, Northern Spain, and large tracts in India and North America, with the whole of the British Isles as far as the valley of the Thames, were buried under ice sheets of great thickness.

We who live among the pleasant Malvern hills and the fertile valleys of Worcestershire, Gloucestershire, and Herefordshire, can hardly comprehend what is inferred in the term "an ice-ridden continent." It requires a voyage to Greenland to realize the magnitude of glaciers in a glacial country; the extension of vast ice fields owing to the precipitation of snow; the traversing and grinding of straits and fiords by icebergs when, for a while, the ice breaks up; and the transportation of moraine matter and erratic rocks and boulders. But as few would care to visit Greenland if they could, perhaps the next best thing is to trace the *ancient* glaciers of Switzerland where they came grinding down the valleys, far, far above the existing glaciers, in times before the Pierre-à-Bot was stranded above Lake Neuchâtel; when the Jura had their local glaciers, and the old glacier of the

* The student is referred to Lyell's "Principles of Geology," Croll's "Climate and Time," and Geikie's "Ice Age."

Rhone filled the Lake of Geneva and rose high on the mountain sides. Remains of great glaciers may also be traced among the fiords of Norway; in the valley of Argelès in the Pyrenees, and in the valleys of La Pique and the Garonne; while Sir Joseph Hooker found the famous cedars of Lebanon growing upon an ancient moraine.

But it is not only among mountain lands the Geologist finds evidences of the Ice Age. Enormous sheets of *land ice* extended over Northern Europe, Great Britain and America, owing to the precipitation of snow over continental low lands now the habitation of man, and morainic debris and erratic stones mark the transit of these ice sheets. Professor Carvell Lewis describes a vast terminal moraine in Pennsylvania four hundred miles long. The ice which carried the erratic stones and boulders crossed the summit of the Alleghanies over 2000 feet above the sea, while where it crosses the Delaware the elevation is only 250 feet. Sir Joseph Hooker,* Col. Godwin Austen, and Mr. Drew bear testimony to the former great extension of the glaciers of India.

Wonderful are the climatal changes which have occurred in the northern hemisphere since the close of the Pliocene periods; changes which have profoundly affected the life and range of animals and plants. It is to the various climatal and geographical changes which have occurred *since the Glacial Epoch set in*, that we must assign the extermination of many large Mammalia which roamed in vast herds over Europe in Pliocene and Pleistocene times.

* Himalayan Journals, vol. i. p. 221

This Earth, as regards the number of great beasts with which it was stocked in Pliocene times, has been graphically described by Mr. Wallace as a "zoologically impoverished world, from which all the largest, and fiercest, and strongest forms have but recently disappeared."

A few years ago no Geologist suspected that the Glacial Epoch was broken into by warm, or, as they are termed, "Interglacial Periods;" but it is now certain that the cold which set in towards the close of the Pliocene tertiary period *was not continuous*, but was relieved after the lapse of thousands of years by a comparatively warm period, during which Europe and North America, after being ice-ridden for long ages, was again the home of large herds of elephants, rhinoceroses, hippopotami, bison, horse, Irish deer, reindeer, stags, wild boars, bears, cave lions, hyænas, and other carnivora.

The denudation which has affected the country within view of the Malvern Hills since the period of the setting in of the Glacial Epoch and that of the great submergence of land beneath the waters of the Glacial seas is enormous, as may be gathered by those who will study the Glacial Drifts. It is my belief that great masses of Old Red rocks and Carboniferous strata which once lay over the whole of Herefordshire, and joined together the South Wales coal-field and its outlier Pen Cerrig Calch on the S.W. with the Cleve Hills in Shropshire on the N.E., have undergone much denudation since the setting in of the First Glacial Period. If we turn to the eastern side of the Malverns and look upon those great outliers from the Cotteswold range, Robin's Wood and

Chosen Hill near Gloucester, and Oxenton and Bredon Hills beyond Tewkesbury, we who know the history of the Drifts know also that the Oolitic and Liassic strata once extended over the vales of Worcester and Gloucester, and that the denudation which has removed whole platforms and areas of table lands and cut out our valleys, is subsequent to the setting in of the Ice Age and the Great Submergence.

There is no man who has studied the complicated Drift phenomena of the Cotteswold country so much as my friend Mr. Lucy, and as regards the effects of the Ice Periods upon the physical contour of the country, we find him declaring "that when the Glacial Period set in, the Cotteswolds stretched much farther to the westward than they do now," and insisting that the denudation of the Cotteswolds took place "at an early part of the Glacial Period."

GREAT SUBMERGENCE OF LAND AREAS.

Whatever may be the cause, there is no doubt that the coming on and passing away of a Glacial period is connected with great movements of subsidence and re-elevation of land.*

After the great Ice sheet had attained its full development on the land, came the setting in of the *Great Submergence* of European and American areas. This movement of subsidence and after elevation appears to have increased in depth as we travel westwards. Wales was submerged deeper than the eastern counties of Norfolk and Suffolk, and a considerable area of land to the westward of Wales and Ireland has never re-

* See Croll's "Climate and Time."

emerged from the deep. Large areas of Pre-glacial lands in Europe and America were submerged beneath the sea after the climax of the First Ice epoch, as is proved by masses of shell-bearing gravels and sandy drifts, often containing erratic angular boulders, which overlie the Boulder clay or the land moraine matter of the great Ice sheets. Marine shells in numerous localities testify to the presence of the sea waters which rolled above the submerged areas, and there is evidence that this glacial sea was often traversed by floating icebergs, as now happens in Arctic seas and estuaries.

The Drifts which are deposited along the line of the Severn Straits, whether they occupy high levels or low levels, contain pebbles and erratics from the north, and were therefore named by Sir R. Murchison, "Northern Drift."

HIGH LEVEL PLATFORM DRIFTS.

During the great submergence which succeeded the glaciation of vast land areas in the First Ice epoch, those High Level Platform Drifts and gravels were deposited which we find upon hill plateaux now cut off by intervening valleys and eroded land surfaces from their fellow drifts, and which are met with at considerable heights above the higher valley gravels. Such are the celebrated Moel Tryfaen drifts, now isolated from drifts with which they were once continuous on the flanks of Snowdon, of Carnedd Davyd, and other Snowdonian hills.

On the highest platform of Bredon Hill (an isolated outlier of Oolite and Lias opposite *Malvern*) may be found the well-known pebbles

of the "Northern Drift," which also occurs on Cleeve Cloud, the highest plateau of the Cotteswold range, 1,093 feet above the sea. Mr. Lucy has shown how similar drifts have been deposited at many localities on plateaux of the Cotteswolds, when those hills were submerged beneath the waters of a glacial sea. These drifts were once continuous although now separated by deep valleys and intervening land areas.

The Malvern axis appears to have been swept clear of these High Level Platform Drifts, probably by a persistent current from the north. The only exception I know is the presence of some stratified sandy silts which occur between the Wych and West Malvern, at the back of the residence of the Rev. Mr. Ford, and to which my attention was drawn by Mr. Walter Burrow. We employed some labourers to sink a pit, thinking it possible we might find boulder clay at the base. We were, however, obliged to desist, owing to the danger of the mass of stratified silt falling in upon the workmen. We found no erratics and no sign of marine shells, so I was inclined to rank these silts as Glacial *land debris*, when I was informed that similar beds were excavated in cutting the foundations for "Wychcrest," the residence of Mr. Canning. Mr. Thomas Holland, of Malvern Link, showed me a rolled lias gryphite which he is positive he found among several others when the excavations were in progress. These silts have since been observed by Mr. Wickham behind Wychcrest. If, on future exploration, these West Malvern silts furnish lias gryphites, they are Northern Drifts of the

great Submergence Period, and they correlate very nearly as regards height with those on the Cotteswold Hills on Cleve Cloud across the vale of Worcester.

Professor Prestwich discovered a deposit of marine fossil shells in 1862, at an elevation of between 1100 and 1200 feet above the sea, in Vale Royal, three miles east of Macclesfield. The shells of these beds are similar to those of Moel Tryfaen, almost every species being identical. The two localities are 80 miles distant from each other in a straight line, the Macclesfield shell beds being near the watershed in the centre of England.* Other outliers and remnants of these same fossiliferous Drifts have been found by Mr. Mackintosh on Halkin and Minera Mountains, situated a few miles north of the sources of our river Severn, on Plinlimmon, at the height of 950 and 1230 feet with fossil shells, and at about 1550 feet without them.

At different times I have travelled in search of glacial Drifts among the mountains of North and South Wales, and an examination of the hill of Craig Turch in the wild country between Llandovery and Tregarron, convinced me that the hill platform Drifts of South Wales, like those of North Wales, must be attributed to the same glacial history, and were deposited about the same period as the Drifts of Moel Tryfaen.

Mr. Handel Cossham conducted me from Wells to a place called Oranmore, on the highest plateau of the Mendips, near a monument. A pit, west of the monument, was quarried for

* "Antiquity of Man," p. 318.

road gravel, and on breaking the pebbles we found many which belonged to the Northern Drifts of the Cotteswold and Severn Valley.

Lastly, some very important High Level Platform drifts in the districts of Portsmouth and Southampton, Salisbury, the Isle of Wight and Bournemouth, were first described by Dr. Evans of Hemel Hempstead, the distinguished geologist and antiquarian. Nothing can be more marked than the great denudation of the whole country into valleys and sea straits since the deposition of the Platform drifts of Milford Hill near Salisbury and the Foreland of the Isle of Wight. Palæolithic man worked his old stone implements when these drifts were being deposited, for they have been found in Platform drifts which were once continuous from Milford Hill to the Foreland cliffs of the Isle of Wight and the high lands above Bournemouth.

The re-elevation of land above the glacial waters of the first Ice Period was certainly in a cold period, as evidenced by the presence of such animals as the mammoth and Siberian rhinoceros, the musk ox, the marmot, the Siberian hare, the lemming and the reindeer on the re-emerged lands. Many of our English valleys had then no existence, and massive beds of sand and gravel, containing ice-borne erratics, extended over large plateaux of England and Ireland. We know that men were living then, hunters and fishers, over a country whose topography and geography it is impossible to restore, and in waters which have changed into land now covered with our flocks and herds.

HIGH LEVEL VALLEY DRIFTS.

We mean, by the above, Drifts which have been deposited at a high level *on the sides of the valleys down which our present rivers flow*. Professor Prestwich showed how certain shells mark the difference of climate between High Level and Low Level river gravels, and how the old rivers flowed under very different atmospheric and climatic conditions to the present.

In the High Level valley drifts along the shores of the Severn Straits, we find large transported erratics belonging to an earlier period of the drift history, viz., the Platform Drifts already alluded to. These appear to have been washed out of Boulder clay, and brought by floating ice, which stranded, melted, and left them where they lie. There are evidences, too, of streams which have flowed in channels which have long since been dry, and of great inundations and violent floods in valleys now occupied by mere rills.

The difference between High Level and Low Level Valley Drifts may be studied in the diagram given by Sir Charles Lyell of the geological structure of the Somme valley in his "Antiquity of Man." In the Malvern district they may be observed in the field by walking from the Low Level Drifts at Ripple Station between Upton-on-Severn and Tewkesbury to the High Level Drifts on the summit of Sarn-hill, and the hill above the Moss Green at Bushley. Mammalian remains have been found at both these localities.

I have directed attention in other works *to the finding of Boulder clay and Northern*

drift below a mass of angular debris when digging the foundations of the Imperial Hotel at Malvern, 300 feet above the sea.* These are High Level Valley Drifts of the Severn valley as compared with the Low Level Drifts at Upton-on-Severn which were exposed near the railway station. Both these drifts furnished teeth and bones of the mammoth and Siberian rhinoceros, but the fossils are far better preserved in the higher than in the lower gravels.

Across the Severn, opposite Sarnhill and the Moss Green hill, is Shuthonger Common and Twynning. These are High Level Drifts as compared with the Low Level gravels at the Oxeye pits, Bushley, and those at Ripple village. I have recorded remains of *E. antiquus* from Twynning and *E. primigenius* from Bushley.

High Level drifts rest on Apperley Hill, Deerhurst. Here were found some good-sized erratics, and among them rolled masses of Shap and Criffel granite.

On the platform of Tunnel Hill, at The Eades, above Upton-on-Severn, there is a mass of sand and silt, with a few Northern drift pebbles and some triturated shells.

On the Avon the difference of position between High Level and Low Level gravels may be seen by visiting Little Comberton and Cropthorne, and then the low levels at Fladbury.

The High Level drifts at Little Comberton are famous for the hippopotamus teeth and tusks obtained by the Rev. Mr. Parker and Mr. Hugh Strickland; a fine tusk may be seen in the Worcester Museum.

* "*Records of the Rocks*," and "*Severn Straits*."

From the High Level valley gravels at Cropthorne Mr. Strickland obtained bones and teeth of the mammoth, rhinoceros, hippopotamus, and cave lion,* which were associated with *unio littoralis*, a fresh-water shell still living in the Loire in France.

LOWER LEVEL VALLEY GRAVELS.

These drifts occupy a few feet above the flood level of the present rivers, such as the Worcester gravels, those at Upton-on-Severn, the Oxeye pits between Tewkesbury and Bushley, the Defford and Fladbury gravels on the Avon. All these localities have furnished specimens of bones and teeth of the mammalia already alluded to. At Worcester, Kempsey, and Upton-on-Severn, estuarine shells have been found, such as *turritella*, *purpurea*, *anomia*, and *cardium*, showing that these gravels were deposited in marine waters, whereas the silts which occupy the Hams, or Severn meadows, contain only fresh-water shells.

We occasionally meet with large erratics of Scotch granite, diorite and Dudley toadstone (a trap rock), which were probably washed out of higher drifts. A boulder found close to the town may be seen used as a corner-stone in the Pig-market at Upton.

The Ripple Low Levels and those on the opposite shore of the Severn at Holdfast, have both furnished the remains of the mammoth and large erratics. The Low Level Avon gravels at Defford, Pershore, and other places have furnished numerous mammalian remains,

* *The last vertebra*, named by Professor Boyd Dawkins.

and many bones and teeth of mammoth, rhinoceros, &c., and the Rev. Winnington Ingram possesses a fine collection from the Lower Level gravels at Fladbury and other localities. It is somewhat singular that the Low Level Avon gravels should yield only fresh water shells, and I believe this may be accounted for by the fact that the sections do not go deep enough, for on the other side of Bredon Hill, near Beckford, there are two drifts, the upper containing fresh water shells, and the lower some marine shells, such as turritella, anomia, and portions of cardium. Here Mrs. Crompton Hutton found rissoa, and Sir W. Guise lucina borealis. It is therefore probable that if we only went deep enough marine shells would be found at the base of the Avon drifts.

CAVERNS AND CAVE MEN AND ANIMALS.

The study of the Valley Drifts and Gravels leaves no doubt that the Cavern Mammalia (so called from the bones and teeth of many wild beasts having been preserved in caves and rock fissures) were living in England in great herds when the Severn, Wye, Avon and Usk were running in the same direction as now, and were depositing their valley drifts at different levels.

The details of our Cave Hunting have been described elsewhere,* I shall therefore only allude here to caves within tolerable distance of Malvern. First we have King Arthur's Cave on the Wye, within easy reach of Symond's Yat Station between Ross and Monmouth, or

* "Records of the Rocks," p. 350.; "Geol. Mag.," Oct., 1871; "Severn Straits," p. 36.

the village of Whitchurch on the Monmouth high road. The bone caverns, King Arthur's Cave and Bannerman's Hole, are on the Great Doward, 500 feet above the river Wye, and are mere fragments of limestone fissures, which were once much longer, but worn away at their northern extremities by atmospheric denudation of ages. Nevertheless, they were hyæna dens, into which those animals dragged portions of carcases and heads of mammoth, rhinoceros, horse, bison, Irish deer, cave lion, bear, wolf, and beaver. Human implements were found under two thick stalactite floors associated with the bones of the wild beasts, in such positions as to render it certain that the men of the Old Stone (Palæolithic) Age frequented the hyæna dens as a place of shelter, as in these days the African savage shelters from storms in caverns frequented by hyænas and bears. These Doward caverns do not open out upon the river Wye, but face the Little Doward. There are caves in the limestone escarpments on each side the Wye, but in them we found no traces of cavern mammalia, but they yielded bones and teeth of the common brown bear, the badger and the wolf.

The only other caverns within easy reach of Malvern, are the Banwell cave near Weston-super-Mare, and Wokey Hole, near Wells.

The great point which I wish my readers to remark is that the Cavern Period, with its extinct animals, was intermediate between a first and second Ice age. This is proved by observations among the Alps,* the position of *boulder clays* and drifts in various parts of the

* "Severn Straits."

Continent of Europe and Great Britain, as well as the fact that glaciers are known to have descended from the mountains, past the mouth of the Victoria Cave in Yorkshire, the Cefn caves in North Wales, and near Mentone on the shores of the Mediterranean. It is, I believe, most important that Geologists should realise that there were two periods of glaciation, and that the Second Ice Age set in *since the Cavern period.*

SECOND ICE AGE.

It is not only the Caverns which afford evidence of the return of an Ice Age, which I doubt not was the cause through the glaciation of the land of the death of great herds of mammalia, the total extinction of some species, as the mammoth, the Siberian rhinoceros, and the great Irish deer, and the migration southwards of others. The extirpation of thousands of mammoths and other mammalia in New Siberia was probably owing to the return of a rigorous glacial climate.

In the Malvern district we are able to indicate certain phenomena which we believe appertain to this Second Ice Age. From time to time striated and polished rock surfaces are laid bare, especially along the North Hill, where boulder clay, containing large erratics, has been exposed.*

Fifty years ago, Birtsmorton and Castle-morton Commons were studded with large angular fragments of gneissic and Silurian debris, and gravel pits were worked as low down as Birts Street, Birtsmorton. The large stones

* See "Severn Straits," p. 47.

which studded the surface have long since been broken up for road material, and the old gravel pits are no longer worked; but both the big stones and the gravel debris were morainic matter belonging to a second cold period when great masses of snow and ice filled all the coombs and valleys along the Malvern Hills, and this cold period was rife when the valleys were eroded to their present depths.

Glacial drifts have been deposited upon low hills in the valley of the Severn Straits; the summit of Limbury is capped with Northern Drift, at the base of which Mr. Lucy obtained a large angular mass of Caradoc sandstone worn and rubbed. I believe this mass of rock and other Silurian erratics found with it, were floated down the Severn Straits and dropped where they were found, during the submergence which followed the Second Ice Age.

I have recorded an important section of Drift in the valley below Haffield.* Mr. Lucy has recorded, in the "Transactions of the Cotteswold Field Club," how we found here a large erratic of Aymestry rock, angular, polished, striated, and resting on a grooved surface of Bromesberrow sandstone. This ice-grooving and ice-carrying must have occurred during the Second Ice period, for the valleys were excavated to their present condition when these erratics were deposited.

Clincher's Mill gravel pit, near Eastnor, is an example of moraine matter at the base, overlaid by water-deposited gravel and drift. This old land moraine must belong to the Second Ice Period, for it was deposited when the valley

* See "Severn Straits," page 48.

was cut down to its present configuration. Among a mass of local erratics at the base of the section quarried for wall building at East-nor, many were of large size, and consisted of slabs of Malvern syenite, Llandovery conglomerate, Aymestry limestone, and Ludlow rocks, all of which were dropped by the ice against the Wenlock shales of Clincher's Mill Wood. All were angular and a few scratched. The base of this pit is no longer exposed. In the upper gravel drifts, Henry Brooks, of Ledbury, found the worn molar of a mammoth, which is now in the Grindrod collection at Oxford. These upper gravels contain lias gryphites. I took Professor Prestwich to see this section, but the moraine at the base was not exposed.

It is impossible to study such sections as those presented at Haffield and Limbury, without feeling certain that *Ice action was at work when our Malvern valleys presented much the same configuration as at present.*

I have often been asked whether the tracks of old glaciers can be reached from the Malverns. It is well known that the Snowdonian valleys were formerly filled with glaciers. Their moraines and roches moutonnées were described by Dr. Buckland in 1842, and many a happy day have I passed among the extinct glaciers of North Wales in search of blocs perchés, and of Alpine flowers, such as the spidertwort and moss campion, which still linger among the precipices of the Glyder or Carnedd-y-Gwynt.

The last time I visited Snowdon, Sir William Guise gathered the moss campion (*Silene acaulis*), that flower whose blossoms are found

upon the highest peaks of the Matterhorn, and among the snows of Franz Josef Land. It grew upon a *roche moutonnée*.* But it is not only at Snowdon and the mountains of North Wales that old glacier tracks may be observed.

Several members of the Malvern Field Club have accompanied me on explorations among the relics of glaciers on the hills and valleys of South Wales. Small terminal moraines near the head of some of the valleys of South Wales are so fresh that I am disposed to refer them to a later recurring cold period than the close of the Second Ice Age. Such is the terminal moraine at the base of the Drygan Mountain, in the wild Welsh district between Llanwyrtyd Wells and Rhayader. This moraine dams up the tarn Llyn Carw, famous for its great trout, said to have been introduced by the monks of Strata Florida. Moraines of a far larger glacier of the Second Ice Age may be traced for miles down the valley by the Wolf's Leap, a glacier evidently belonging to an earlier age than the short glacier among the rocks of Drygan.

A small terminal moraine forms the dam to Llyn-y-van on the Vans of Caermarthen. The moraine is made up of Old Red conglomerate, and was swept into its present position by an ice sheet reaching from the summit of the Vans; it is evidently of a later date than the moraines of the Second Ice Age, which traverse the valleys towards Trecastle on one side and Llandovery on the other.

Sir John Lubbock suggested the terms "Old Stone Age" (*Palæolithic*) and New Stone Age (*Neolithic*) as representing two great periods,

* See "*Glaciers of North Wales*," by Sir A. Ramsay.

during which Ancient European Man used stone implements—those of the earlier ages being of rude form and simple design, while the latter are sometimes artistic and elaborate in their manufacture.

It may be supposed that the geologic records of Palæolithic men graduate gently into those of the Neolithic men ; but it is not so. A great gap, a gulf of time, intervenes between them. We find Palæolithic man feeding upon the herds of reindeer which, after the interglacial Cavern period, the on-coming cold of the Second Ice Age, had driven to Central France ; and when, without doubt, the reindeer moss, the Alpine birch, and the Alpine willow, was the principal vegetation on which those herds pastured in the lowlands of France, or the lands of Gower.

An arctic or sub-arctic vegetation again covered large areas in Europe ; areas which were again frequented by the Northern mammalia, the mammoth, the reindeer, the Siberian rhinoceros, the tailless hare, and the lemming.

Palæolithic Man was an artist and sculptor as well as a mighty hunter. His rude drawings of the animals of the chase were engraved upon the fresh bones of the mammoth, or the antlers of the reindeer, and the last we know of him is among the northern mammalia and the Arctic plants upon which they fed.

The first we know of the appearance of Neolithic Man, is after the cave mammalia had died out or been driven southwards by the advancing cold, and after great geographical changes in the position of land and waters. The mammoth and several of his contemporaries had disappeared for ever from the world of life. The

cave lion and the hyæna no longer wandered in our forests, and the existing Germanic flora had succeeded to that Arctic vegetation which was driven from the lowlands of Europe to the mountain tops.

Here then there is a great hiatus not as yet accounted for in the geologic record, and it is represented by that unconformity which may sometimes be detected between Glacial and Post Pleistocene deposits; a matter of indifference to a casual observer, but really the representation of long ages in the lapse of time.

Relics of Neolithic Man were discovered in the Malvern district at West Malvern; they consisted of flint flakes and flint knives, and were found below a mass of Syenitic debris, on the surface of the rock, when building a house near the Westminster Arms. I saw them in the possession of the late Rev. Frederick Holland, Vicar of Evesham.

No term in Geology has been so much misused and misapplied as the term, "*Post Glacial*." Only a few years ago, geologists of eminence applied the term Post Glacial to the cave phenomena and cavern deposits, whereas we know now that the climate of Great Britain became again severely glacial after that warm interglacial epoch, when hyænas dragged their prey into our caverns, the lion roamed on the banks of the Wye, and hippopotami swam in our Shakespeare's Avon.

Now, inasmuch as many Pleistocene animals ceased to exist, or to frequent Europe, after the cold of the Second Ice Age, and small glaciers have filled the heads of valleys in Scotland and Wales in comparatively recent times, I think

it better to get rid of the term *Post Glacial*, and use that of *Post Pleistocene*, as more applicable to the recent deposits of our British Isles.

Amongst Post Pleistocene deposits we reckon those river and estuarine silts which filled the hollows of our valleys, as the estuary of the Severn Sea, the Hams and Holms on the banks of the Severn river, the Avon, or the Wye; our silted up marshes, as Longdon and Castle-morton meres; the extensive submarine forests which fringe the coasts of Great Britain, and which have been submerged and covered by the sea, since the period of the Second Ice Age; the fen beds of Cambridge and Lincoln; the raised beaches along our coast lines, and the peat bogs of Britain generally.

It only requires experience in the field to be enabled to detect numerous examples of great unconformity between the Post Pleistocene beds and the boulder clay below them, an unconformity which ever indicates a great chasm in the geological evidence. Great changes have taken place in Post Pleistocene times. There is no doubt that our rivers Severn, Wye, Avon, Lugg, Usk and others, have flowed in Post Pleistocene times in greater volume than now, and that their streams were broader, the river shingle and loam everywhere testifies.

Post Pleistocene Geology is yet in its infancy, and much remains to be explained respecting the phases of the last Glacial Period. We look to the Astronomer and the Physicist for aid, and I believe that the theory advanced by Dr. Croll is the true one, viz., that oscillations of cold and warm climates are due, with *other causes*, to the eccentricity of the earth's

orbit. But it is necessary to associate with the astronomical cause, geographical changes of elevations and depressions of land.

What geographical and climatal changes do Drifts represent ! Probably they involve a period of many thousands of years, if we could only define the time of their distinct deposition.

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